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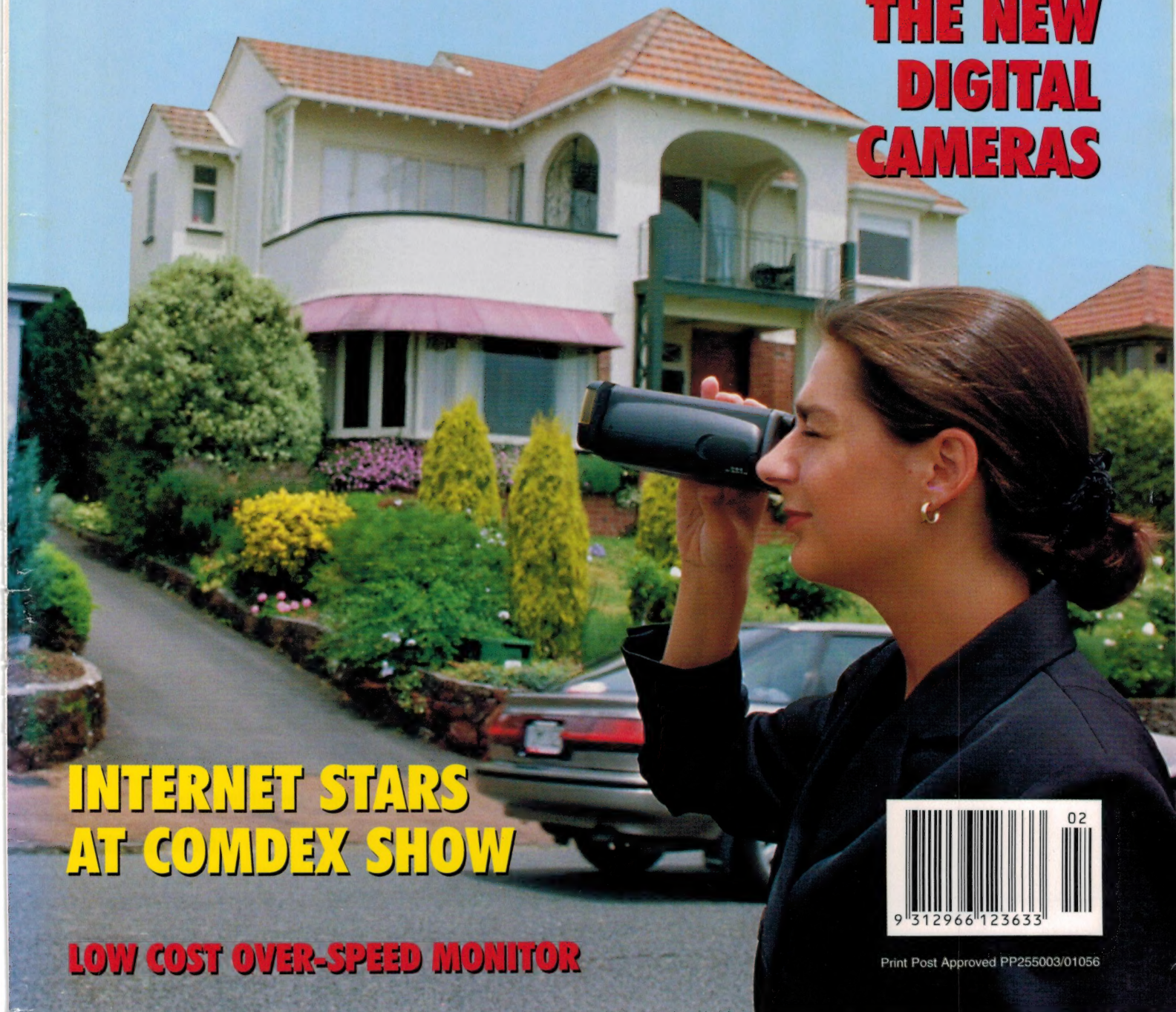

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AUSTRALIA with Professional Electronics & ETI

Volume 59, No.2
February 1997

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Chinon's ES-3000

As part of this month's look at the new digital cameras, we decided to get a better 'feel' for their operating convenience — and performance — by trying one out for ourselves. We chose the Chinon ES-3000, a model near the upper end of the consumer category. What we found is explained in the article starting on page 24.

Compact kit speakers

Jaycar Electronics has just released these new 'JC30' compact two way hi-fi speakers, which come in low cost DIY kit form (but with the boxes already assembled). Tested in our lab, they gave an impressive account of themselves — see the review by Rob Evans, starting on page 69.

On the cover

A real estate agent uses one of Kodak's new DC50 digital cameras to 'capture' a property. Back at the office, the picture can be loaded into a PC and printed out in a flyer or newsletter within minutes, if needed. See this month's feature on the new cameras, starting on page 16. (Photo courtesy Kodak Australia.)

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Projects and Technical

Columns and Comments

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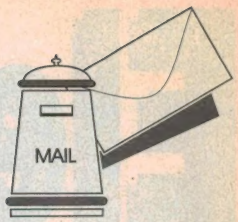
LETTERS TO THE EDITOR



Get it right!

I wish to point out a trivial typo in your article on page 106 of the December 1996 magazine, concerning the MITEC contract for supply of satellite communications equipment.

The division responsible for this project is Defence Materiel, not Material as reported. The word 'materiel' is probably not a common term outside of the military environment, and generally refers to the collective equipment, arms, parts and stores acquired by a Defence organisation.

Understandably, a fast typist would probably not twig to such a term. In addition, most of the common spell checkers seem to suggest the word to be misspelt.

Phil Smith
(Via the Internet)

We didn't type it in, Phil, but it looks as if the spell checker in our OCR program 'corrected' it for us...

Kit disappointing

Your views would be appreciated concerning my recent effort to build a micro-based ESR & Low Ohms Meter as per your January 1996 article, using a kit from one of your frequent advertisers. To some extent I brought the problem on by not enquiring what they meant by 'Short Form' kit. I expected that I would have to find a case, test leads and the like; but certainly not the very heart of the meter: the Z86E0408 programmed microcontroller. Particularly as your article stated specifically that microcontrollers will be supplied with kits.

A note asking the supplier about this was answered promptly by a phone call from a fairly polite but adamant representative, who indicated that:

1. I should have known from the price that the micro was not to be included;
2. What you put in your article does not necessarily apply to his sales policy;
3. Sales would be poor if the kit price was raised to include the micro.

However:

1. There must be lots of constructors like me who do not buy frequently enough to be able to judge this sort of thing; and who go for the 'best buy' assuming the various offers to be comparable.
2. Why not? It seems that other firms are prepared to observe your guidance in this regard. Could not this be enforced as a condition of the use of *EA*'s name in connection with a kit? (Does he pay royalty on the copies of your articles included in such kits?). I can see that his opinion will impress you much more than mine if weighted only according to our respective contributions to your commercial success; but how about something to help avoid this sort of situation?
3. Are we potential customers so gullible as to buy half a kit because it costs less than a useful one?

In the meantime, I have had an unexpected additional outlay, and had to disappoint a friend waiting anxiously to assess the meter for his purposes. I doubt that he will procure his kit from the same firm.

Just for the record, may I have your definition of Short Form? I have not been able to source it.

E. Gordon Wormald,
Florey, ACT.

Unfortunately the definition of 'short form' does seem to be rather vague, Gordon, although like you we'd normally assume it to include at least the components required to build the 'heart' of the project. With the ESR & Low Ohms Meter we would certainly have expected the programmed micro to have been included, even in a 'short form' kit. We can't really control how our advertisers market their kits, but we do try to help whenever it's possible by clarifying what's included in short-form kits when we announce them.

Sympathy message - 1

I was very saddened to hear about the passing of Neville Williams and wish to convey my heartfelt sympathy to *EA* and Neville's family.

Jim, I am of a similar age to yourself, I suspect. This is probably one of the reasons I have appreciated the articles of Neville Williams so much. Neville provided some excellent background for my earlier hobby days.

I have been buying *EA* (*RTV&H*, etc) since 1955 and have always had a keen practical interest in electronics. Like you

(I think it was mentioned some stage in *EA*), I built up the 1956 5" TV with the 5BP1 picture tube, the 6AC7 IF strip, the 6H6 metal valves, voltage multiplier etc. That was finished in 1959 when I did my Leaving Certificate. My keen interest in electronics probably led to my life long interest in science.

I am a senior lecturer in teacher education at the University of NSW and have a PhD in physics. A large part of my research in physics over the years has involved developing electronics projects to help in my physics research into high temperature superconductors. (I have built counters, voltmeters, temperature controllers, phase locked oscillators, computer interfaces etc). *EA* has been a great source of ideas.

In recent years, the 'When I Think Back' series has been particularly interesting as I used it as the basis for a General Studies course I offer at the University. The course 'Communication and Electronics in the 20th Century' has used many of Neville's articles.

Again, thanks for a great magazine. Neville will be sadly missed.

Arthur Anderson
(Via the Internet)

Sympathy message - 2

Your editorial in the December 1996 issue reminded me that I have been regularly reading this magazine for 50 years now. During that time the name Neville Williams and the name *Radio and Hobbies* seemed to be inseparable. While I do not remember meeting Neville Williams face to face, I felt that I knew him through his writing.

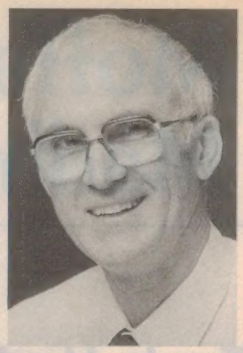
The series 'When I Think Back' brought back many memories to me. Although I had not met the people concerned, their names were familiar, and many cases I had used the products of their labours. A notable exception was Dr Ernie Benson, to whom I owe my enduring interest in electronics. As a sixteen year old student I spent several vacations at AWA in Ashfield where I learned quite a lot about quartz crystals.

Please allow me to share in your sadness at the passing of Neville Williams, and to join you in extending my deep sympathy to Mrs Williams and the family.

Bob Halliday,
Killara, NSW. ❖

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We welcome contributions to this column, but reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



Are digital cellphones safe?

A few days ago, someone who was considering the purchase of a digital cellular phone asked me whether they were safe. He'd been assured by a spokesperson for one of the carriers that they were 'perfectly safe', but had been sufficiently cautious to want a reasonably unbiased opinion.

I suspect that the person concerned was again expecting a simple and unequivocal 'yes or no' answer from me. As a result he was probably rather disappointed with my reply — which was much less clear cut, as well as a great deal longer.

The fact is, though, that as things stand and despite what the cellular mobile phone carriers may wish you to believe, the matter is far from resolved. The health aspects of handheld cellular phones are very much the subject of ongoing scientific research and vigorous debate around the world. This will come as no surprise to any of our readers who have been following the discussions of this subject in the Forum columns.

The reason why most of the carriers and many of the health and safety authorities are blithely claiming that there's no risk from a cellphone operating next to one's head, is that the levels of RF energy density absorbed by the brain are generally too low to cause significant heating. And just about all of the existing safety standards are based on the idea that any possible tissue damage would be solely caused by heating — so as one researcher wryly commented, the assumption is that "if your brain isn't cooking, these things must be perfectly safe". A worrying assumption, I think you'll agree.

In any case, there's been quite a lot of solid research evidence suggesting that at the RF field intensities produced by a cellular phone, damage can still occur to the DNA in the thin membranes surrounding and forming the interfaces between nerve cells. It remains to be seen whether this DNA damage can be linked directly to cancer and brain tumours, but this certainly seems to be a possibility. There also seems to be a possibility that digital cellphones *may* be more of a worry than the analog variety, for reasons to do with their modulation spectrum.

Only further research will answer these questions one way or the other. In the meantime, I believe it's important for consumers to be aware that there *may be* possible health risks associated these extremely convenient and useful communications devices.

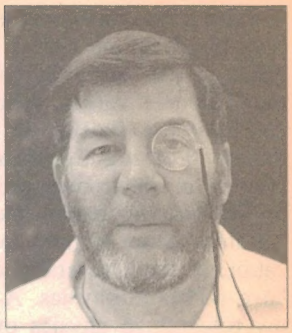
Of course we're talking here mainly about hand-held cellphones, not the in-car variety which operate via an antenna outside the car. Most researchers seem to agree that the latter are likely to be far less of a risk.

Perhaps I'm being over-cautious, but in my opinion it would be prudent not to use one of the hand-held phones (especially a digital unit) any more frequently than is necessary, until the possible health risks have been properly and conclusively evaluated. And if you *are* using one, do yourself a favour and extend the antenna fully — leaving it inside the case may look more suave, but it forces the transmitting circuitry to crank up the output power in order to achieve reliable contact with the nearest base station. If there *does* turn out to be a health risk, that would almost certainly make it worse...

Jim Rowe

Moffat's Madhouse...

by TOM MOFFAT



Tesla Updates, and Other Oddities...

Isn't it interesting what gluttons for punishment we humans are? You get abused, reviled and chastised for something, and then come back for a second dose. You'd think that after stirring up a hornet's nest once, and getting stung many times over, we'd give up. But oh, no... here we go again.

You may remember some time ago in *Electronics Australia*, an article about the life and times of one Nikola Tesla. This gentleman was known as possibly the world's most gifted scientist and inventor by some people. But among others, he was the world's greatest crackpot.

People in the 'crackpot' camp are the most passionate believers in their views, and they are the ones who were inspired to write so many abusive letters to the author of the Tesla article — me — as well as the usual letters to *EA* editor Jim Rowe demanding that I be fired for writing such drivel.

Tesla was best known for his inventions involving electricity; he was the originator of the spectacular Tesla Coil seen resurrecting monsters in Frankenstein movies. But his use for the coil was somewhat more practical — transmitting electric power from one place to another without the use of wires. It wasn't a pie-in-the-sky scheme; it did work, in Colorado.

But the technology was never exploited, most likely because commercial power transmission interests wanted to keep wires. This was because wires fed through electric meters, allowing them to charge people for electricity. Tesla's scheme would have given power users the charge without the money, if you get my drift.

Less well known was Tesla's work into mechanical engineering and hydraulics. He designed some rather unique pumps that people nowadays would call 'impossible'. But again, they did work. Tesla's pump-building career started when most kids are still sucking their thumbs, as described in my Tesla article:

It took all of five years (from his birth) before little Nikola came up with his first invention, a waterwheel featuring a turbine without blades. This gadget later matured into a remarkable uncloggable pump which is now in commercial production in the USA.

I saw a working model of this pump, made of clear plastic, in the Tesla Museum in Colordo Springs. It was set up to pump water around in a circle, from the output, through plastic pipes and a valve, and back to the input. The water had been dosed with lots of styrofoam beads which flowed around with it.

If you slowly closed the valve, the water would still get past but the beads would get trapped, backing right up to within the pump itself. But when the valve was opened again, the beads, and water, all flowed smoothly. This kind of treatment would have wrecked an ordinary pump.

Tesla kept working away at his pump projects, finally coming up with a version that used no moving parts at all. He took out a patent on it, 75 years ago, amidst the usual cries of 'crackpot' and 'drivel'.

Well, drivel it may have been, but not to some researchers at the University of Washington in Seattle. They have been working on the 'Tesla Pump' as described in the 1920 patent document, refining it, and miniaturising it down to near-microscopic size. It appears that the main application will be in medicine, as an infusion pump for moving small amounts of fluids for a very long time. Such a pump could be implanted in a person's body, and since there are no moving parts, it would never wear out. It would remain in service forever — for life.

The modern Tesla Pump works on a kind of 'leaky valve' principle. The fluid follows a complicated path of loops which result it in being easier for it to flow in one direction than in the other. So the overall result is the fluid flowing — being pumped — in one direction.

Engineers were able to re-create Tesla's original design by etching the fluid paths into wafers of silicon, exactly as is done to create integrated circuits for electronics. The result looks like a series of pretzel-like loops on either side of the pump chamber. The pump's inlet and outlet valves are about the width of a human hair. The pump chamber itself if about 6mm in diameter and 0.1mm thick.

The pump 'pumps' because of an alternating current charge at an audio frequency which is applied across the pump chamber. The charge makes the walls of the chamber flex in and out, squishing the fluid in the loops back and forth. But since the fluid moves more easily in one direction than the other, there is a constant one-way flow through the pump. It's not very efficient, but if it lasts forever, who cares?

This Tesla project is being taken very seriously at the University of Washington. So far more than $200,000 in public and private funding has been spent developing the Tesla Pump. A team of engineers has been assigned full-time to perfect it. And according to a UW spokesman, "We expect miniaturized fluid systems to be a major breakthrough in new technologies". All this due to the work of a crackpot...

But to borrow a phrase, you ain't heard nothin' yet. It was strongly believed that Tesla had succeeded in developing a death ray that could destroy men and machinery 'to a distance of 250 miles'. This was mentioned briefly in my *EA* Tesla article, in connection with some alleged nefarious activities of the United States government:

As for Tesla's 'disappearing' research notes, papers associated with such things as the death ray project

are now said to be held within a top security US government vault, where they remain to this very day. Public information about Tesla's death ray is very sketchy, but it is definitely known that the device was based on a particle-beam principle. It just so happens that a particle-beam weapon was a main feature of the United States' 'Star Wars' program that was under development right up until the end of the Cold War.

Further research suggests Tesla also had a much more sophisticated death ray, and he may have in fact developed a laser-like device. Apparently his early death rays simply directed lots of radiant energy at a target. One model was able to explode a charge of gunpowder or light the wick of an oil lamp at a distance of 10 metres.

This concept sounds exactly like a gadget being developed at the University of Tasmania several years ago to ignite 'controlled burn' bushfires from a distance. It was a powerful laser, connected to shoot backwards though a large reflecting astronomical telescope, the whole works mounted on the back of a truck. The telescope could be aimed in any direction to fire a charge into a forest, starting a carefully placed fire.

Ionised a path

But Tesla's first death ray was small beans compared with what was to come later. The most successful design used a laser-like light source operating on ultraviolet wavelengths to ionize a path through the air along the beam, making it electrically conductive. Then all Tesla had to do was connect the beam to one of his enormous electrical generators to electrocute the target on the far end of the beam.

And only this week there was an announcement of a new United States government project — an aircraft-mounted death ray. This weapon is to fly around, keeping an eye open for missile launches. When a launch is detected the aircraft immediately shoots out a death ray, instantly annihilating the missile just as it clears the launch pad. The remains of the missile fall back to earth, instantly annihilating the baddies who set it off in the first place.

The announcement of this weapon was somewhat vague in detail, but the word 'laser' was mentioned. And footage of the test model was shown on television — a Boeing 747 jetliner, and inside, the whole aircraft was filled with something that looked like an enormous white trombone, with its business end pointing out the nose of the aircraft. Could this have been some kind of a 'folded' laser? Are such things possible? The world's biggest fibre-optic thing? Even more interesting would be to know if this device operates on ultraviolet frequencies. Apparently the range is specified as 250 miles.

Since we are stirring up trouble today, let's rattle another cage: cellular phones and cancer. This topic was the subject of a major research effort that lead to a rather controversial article in *EA*, an interview on the Derryn Hinch radio program, lots of action in 'Forum', and some memorable fan mail for the article's author (guess who), such as the following:

Apart from the glaring factual errors, Moffat's article on E-M radiation was typical of the puerile, badly researched empty waffle, that is his trademark... While ever you continue to print such rubbish, you are hurting the reputation of a magazine which for many decades has been careful with its facts, and generally researched its articles well.

A Seattle television station recently took up the very same story, along the same lines as that puerile, badly researched empty waffle in *EA*. They even managed to nail an on-camera interview with Dr Louis Slesin, one of the main sources I quoted in the article.

The general thrust of the TV story was that using cellular phones can cause headaches. This was accompanied by footage of people walking the streets of Seattle yapping into their cellphones as the antennas slowly frazzled their brains. There were suggestions about how to minimise the danger, and other details which slip my non-cellphone affected mind at the moment. Because the real kicker came at the end of the story.

After Dr Slesin said his bit, the TV station actually got someone from the cellular phone industry to respond on-camera. The story featured an interview with the PR lady from one of the local cellphone companies, who of course said there was no danger at all in using her company's products.

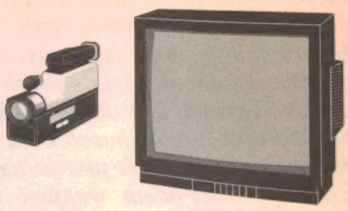
Then the reporter asked, "But what about Dr Slesin's claim that cellphones can and do cause cancer?" The PR lady was quick on her feet: "That may be true, but only in Europe and other overseas areas where they use the digital GSM system. That system is not currently in use in the United States so we have no danger of cancer."

Ooohhh Boy! Did she really say that? Yes, she did say that. I heard her say that. Did I say that? No. I did not say that. I am only reporting the PR lady saying that. Yes. I am a lowly reporter. I need my job. So please, don't any of you write in and demand that I be sacked!

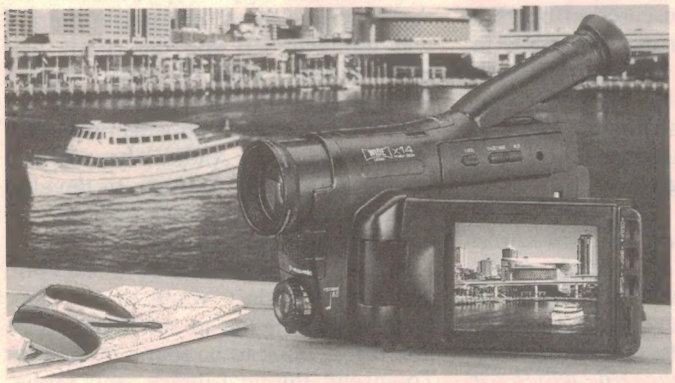
I guess that's enough 'stirring the possum' for one day. I was going to tell you some more Tesla stuff — that some people believe he has travelled to Mars and may be responsible for those strange faces that appear there. I was going to tell you that Tesla was best mates with a guy named Guglielmo Marconi, and that he helped Marconi set up a secret underground city in the Andes where 98 scientists worked on projects to develop free-energy devices and discoid aircraft (flying saucers to you!)...

But no, that's promoting a crackpot, and we wouldn't want to do that. Instead, permit me to refer you to an interesting book to be found in the Port Townsend Public Library, and probably your own library as well: *The Fantastic Inventions of Nikola Tesla*, written by none other than — who else? — Nikola Tesla. See you! ❖

What's New In VIDEO and AUDIO



Panasonic camcorders boast LCD viewer/monitor



Panasonic now has four camcorders with LCD monitors in its range, in response to the growing market demand. The models are aimed at users who want the viewing advantages of a colour LCD monitor in the standard camera format.

The NV-VX1 and NV-VX3 models have a 76mm (3") colour LCD monitor while the NV-VX5 and NV-VX7 have a 100mm (4") monitor. In each case the LCD screen has a non-glare silica coating which resists fingerprints and dirt, and easily wipes clean. Multi-angle shooting is possible because the LCD monitor swivels up or down over a 270° range. Panasonic claims this is particularly convenient when shooting over the tops of other peoples' heads.

The camcorders also feature a built-in speaker with volume control, for instant playback of recordings.

All models come equipped with a wide angle lens featuring an optical zoom range to X14, with a X140 digital zoom on the top-of-range NV-VX3 and NV-VX7. The wide angle capability makes them well suited for filming in small rooms or outdoors for panoramic shots.

A wide aperture lens and sensitive CCD allow excellent indoor shooting in low light conditions. The VX1 and VX5 can film in conditions as low as 0.5 lux, while the VX3 and VX7 can film in 0.7 lux. (One lux is equivalent to the light given off from one candle in a medium-sized room.)

The cameras can also be set on full Auto, Manual, Sports or Portrait for special filming situations. A conveniently-located backlight button helps achieve correct subject exposure in backlit conditions.

All models come equipped with a handy remote control that lets the user control shooting and zooming, from in front of the camera. Also built into the VX3 and VX7 are Panasonic's Auto Power Saver and Anti-Ground-Shooting features, which save both battery power and tape.

The top-of-the-range VX3 and VX7 also have creative digital functions of fade, wipe, strobe, gain-up and snapshot, and a Super Image Stabiliser system which helps suppress hand shake.

The Panasonic camcorders are available from leading electrical retailers, with RRPs of $1999 (NV-VX1), $2199 (NV-VX3, -VX5) and $2399 (NV-VX7). For further information contact Panasonic's Customer Care Centre on 132 600.

High-end THX Surround components from Kenwood

Very well received overseas, Kenwood's showpiece KC-Z1 Surround Preamp/Tuner and KM-Z1 Surround Power Amp have now been released in Australia. The new units incorporate both AC-3 and THX decoding technology and are designed to partner one another to produce what Kenwood claims as the 'ultimate' in surround reproduction. They made their debut at the 1996 Audio Show in Las Vegas.

Together the KC-Z1/KM-Z1 are immediately recognisable by their monumental proportions. A detachable two-way, 900MHz RF remote control with LCD touch screen is said to provide the ultimate in control simplicity, and allows the system to be controlled from anywhere in the home. A proprietary GUI (graphical user interface) provides a simple menu-driven surround setup procedure which ensures optimum home theatre recreation.

The KC-Z1 Preamp/Tuner features the latest in Dolby AC-3 5.1-channel surround sound decoding, with the '0.1' sixth channel for the subwoofer. Unlike regular Dolby Surround Pro-Logic, Dolby Surround AC3 provides stereo imaging for the rear surround channels for added realism. A calibrated narrow band 75dB test-tone generator allows each channel to be set-up correctly for Dolby AC-3 and THX listening.

The KM-Z1 surround sound amplifier has performance to match its impressive appearance. To recreate the realism of today's modern theatres, it delivers six channels of 130 watts, exceeding THX requirements. In 'conventional' stereo mode the KM-Z1 also produces 135 watts RMS per channel.

Both the KC-Z1 and KM-Z1 are built using all discrete components, the preferred choice of many audiophiles. To maintain linear temperature characteristics Kenwood have also incorporated quiet two-speed cooling fans.

Both the KC-Z1 Surround Pre-amp Tuner and KM-Z1 Surround Sound Power Amplifier are covered by a 24-month warranty. The combination has an RRP of $7698.

New hifi speaker range from Jamo

Jamo, which claims to be Europe's largest speaker manufacturer, has just released a new range of quality hifi loudspeakers. The '8-Series' is positioned right in the middle of the mainstream hifi speaker market, and because of extreme competition in the area Jamo has a great deal of care to ensure the range is a success.

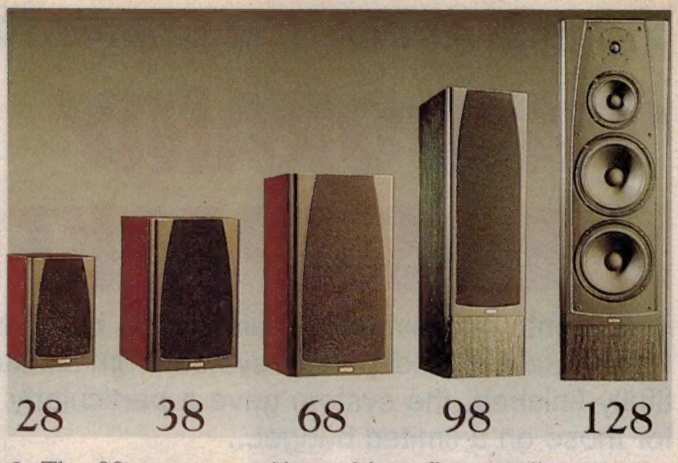
The 8-series consists of five main speakers, (three bookshelf and two floorstanding models), plus a matching centre speaker and versatile surround speaker. Jamo has employed a high-tech moulded front baffle for both an eye-catching appearance, as well as improved performance. All front speakers in the range have a 6-ohm impedance, making them as 'amplifier friendly' as possible.

To achieve the kind of performance levels that are expected, Jamo had to design the drivers themselves. The claimed result is a superb low frequency response helped by the specially designed, heavy diaphragms and heavy duty voice coils.

A further advantage of the woofers used in the 8-Series is that their special design causes a natural roll-off in the uppermost areas of the frequency range. This allowed Jamo's engineers to design a no-loss crossover network, without a coil connected in series with the woofer. As a result even lower powered amplifiers and receivers can easily maintain full control, even at high volumes.

Every model in the '8-Series' range is available in both Black or Mahogany finish. The line-up comprises the following models:

- The 28, a compact two way bookshelf speaker with a 130mm woofer and a dome tweeter. It can handle 55W RMS and has an RRP of $399 a pair.
- The 38, a two-way bookshelf again with a 130mm woofer and dome tweeter but with a larger, although still compact, cabinet. It can handle 60W and retails for $499/pair.
- The 68, a three-way bookshelf with a 165mm woofer and dome tweeter. Power handling is 80W into 6Ω and is priced at $699/pair.



- The 98, a two-way/three driver floorstanding speaker with twin 163mm woofers and effective magnetic shielding, allowing placement close to a television. This system handles up to 90W, and is priced at $999/pair.
- The 128, a tall three-way/four driver floorstander with twin 8" woofers, also featuring effective magnetic shielding. Power handling is 140W, RRP $1499/pair.
- The Centre 18, designed to match the front speakers in appearance as well as sound. It is the same height and width as most hifi components for easy placement in a cabinet, and sells for $499.
- The Surround 8, a compact rear channel speaker that can also be used for purposes such as extension speakers. It sells for $299/pair.

All Jamo loudspeakers are supported by a five year warranty and are available from selected hifi dealers around Australia. For further information please contact distributor Scan Audio on (1800) 700 708 or fax (03) 9429 9309.

CD repair kit

Once scratched, audio CDs can skip tracks annoyingly while CD-ROM discs can be rendered virtually useless. However CD Magic, a product made in the USA, isclaimed to allow fully successful repair of virtually any kind of optical disc format (including Laserdiscs).

Essentially CD Magic comprises a liquid plastic compound that is simply rubbed into the scratched surface, with the excess wiped off. The scratches are then filled with optically transparent material, and effectively removed. The manufacturer is apparently so confident of its efficacy that it offers an unconditional money back guarantee.

One bottle of CD Magic is claimed sufficient to repair up to 25 compact discs.

For more information circle 140 on the reader service card or contact distributor Fox-Com, of PO Box 146, Fawkner 3060; phone/fax (03) 9359 9720. Dealer enquiries are invited.

Rock, brick, nut and frog speakers!

Only in America! Colorado firm Rockustics has added 11 new models to its range of 'simulated stone' outdoor hifi speakers, bringing the total to 24 outdoor speaker models. The company's products are popular in the USA among consumers, audio and electronic retailers as well as commercial clients, including Disneyland, Busch Gardens and Opry Land.

The new additions include Hanging Planter and Planter Speaker models for pool and patio areas, featuring the look of terracotta and adequate drainage to accommodate live plants. Both models are available in 50 and 75W versions and range in suggested retail price from US$320 to $472/pair.

The Frogtone and Squirreltone models have novel animal figurines atop the mouldings, and offer 50W or 75W performance. Suggested retail is US$392/pair for the 75W model.

The River Rock Stonewall, Granite Stonewall and Brick Stonewall models are designed to match construction parameters for perfect blending with existing or new garden walls. These 100W speakers are designed for large outdoor areas and offer fine audiophile range sound distribution. Suggested retail in the wall group is US$940/pair.

CocoNutz is a playful addition that offers serious sound in tropical settings for bars and restaurants, resorts, outdoor dance areas and hotels. These speakers look like actual coconuts and are virtually invisible in the proper environment. The coaxial speaker handles 75W and has a suggested retail of US$464/pair.

Finally there's Stonehenge, offering 150W of audiophile quality sound and a hand finished granite look.

Rockustics is at 15400 East Batavia Drive, Aurora Colorado 80011; phone (+1 303) 363 6161 or fax (+1 303) 363 0011. ❖

Video & Audio: The Challis Report

'DALI GRAND' SERIES SPEAKERS

This month our reviewer Louis Challis had the opportunity to evaluate the new top of the line 'Grand Series' loudspeaker system from Danish manufacturer Dali. Elegantly styled and beautifully finished, the system gave a particularly impressive account of itself — although it's not for those on a limited budget...

Around the middle of last year I received a news release from Scan Audio in Melbourne which caught my eye. The blurb recounted Dali's difficulties in developing its new 'top-of-the-line' loudspeaker system. As I read further, I discovered how Dali had dealt with the multiple problems associated with the cabinet design, and at the end of their R&D program, how pleased they were with the results of their 'Dali Grand' Series of loudspeakers. That confident title 'Dali Grand' immediately conjured up images of very large and expensive loudspeakers.

Four months later, whilst nattering to Michael Henriksen, the principal of Scan Audio in Melbourne, I learnt that the Dali Grands had been developed to satisfy a new and burgeoning market niche in the Orient. Michael recounted how recent dramatic changes in 'disposable income' had created a situation where the *nouveau riche* are willing to devote a significant proportion of their income to purchasing quality hifi loudspeakers.

The key requirement in the loudspeakers for this market is that they must provide superior sound, as well as being visually impressive. Those speaker systems which provide comparable sound quality, but lack the appropriate appearance, have apparently become *passe*. It would appear that the Dali Grands have been carefully designed to fulfil that goal, with an outstanding frequency response whose lower cut-off frequency extends below 25Hz. The other claimed attribute is their ability to safely handle program content whose peak level exceeds 110dB, at normal listening positions.

The original press release provided dimensions, weights, and even nominated how many drivers were used in the design, but little more. The claimed attributes convinced us that a full review was warranted, and so we progressed to the next stage of suggesting that we would like to receive a pair for testing.

When the Dali Grands finally turned up, the carrier complained bitterly about the size of the cartons, and was critical of their weight. Although by no means the heaviest or largest speakers that I have reviewed, there was a clear impression that these speakers were constructed to higher standards than any of the others which I had recently reviewed.

Unusual shape

On opening the first of the two large cardboard boxes, I was confronted by a relatively tall loudspeaker enclosure with an unusually shaped speaker cabinet. The sides of the cabinet and its top were gently curved and contoured. Even the shape of the cloth covered speaker grille had been narrowed down at the waist, unlike the conventional straight-sided versions which most of us now accept as the norm.

Whilst acknowledging that I appreciate the curved shape, and even the chamfered corners, I imagine some readers may hold a different view. Appearance is very much a personal matter, and even I have noticed

how our individual tastes change appreciably with time and age.

When I tried to pick up the unpackaged speaker all by myself, I discovered just how heavy it was. It was obvious that the designers had taken particular care to thicken, stiffen and dampen the cabinet, to optimally minimise unwanted cabinet resonances. The curvature of the top as well as the sides of the cabinet was confirmation of the length and trouble that they had gone to, to fulfil that design philosophy.

My investigations assessing the vibration radiation characteristics of loudspeaker cabinets, using sub-miniature accelerometers, have confirmed that when a cabinet surface is curved, it is less prone to resonate. Increasing the degree or extent of cabinet curvature generally enhances the damping characteristics, and if the number of layers of materials are increased or thickened, a similar progressive enhancement is normally achieved.

Of course the catch with that approach is that there is a 'law of diminishing returns', particularly with respect to the residual internal cabinet volume which ultimately determines the lower cut-off frequency of a vented speaker enclosure.

Obviously, the designers of the Dali Grand had to achieve an appropriate compromise between form and function, and I believe that the end result neatly satisfies both requirements.

It took two of us (actually three if you count the person who had to hold the door open) to safely move the unpackaged Dali Grand loudspeakers into the anechoic chamber. Once there, we gently placed it on the testing turntable ready to be put it through its paces.

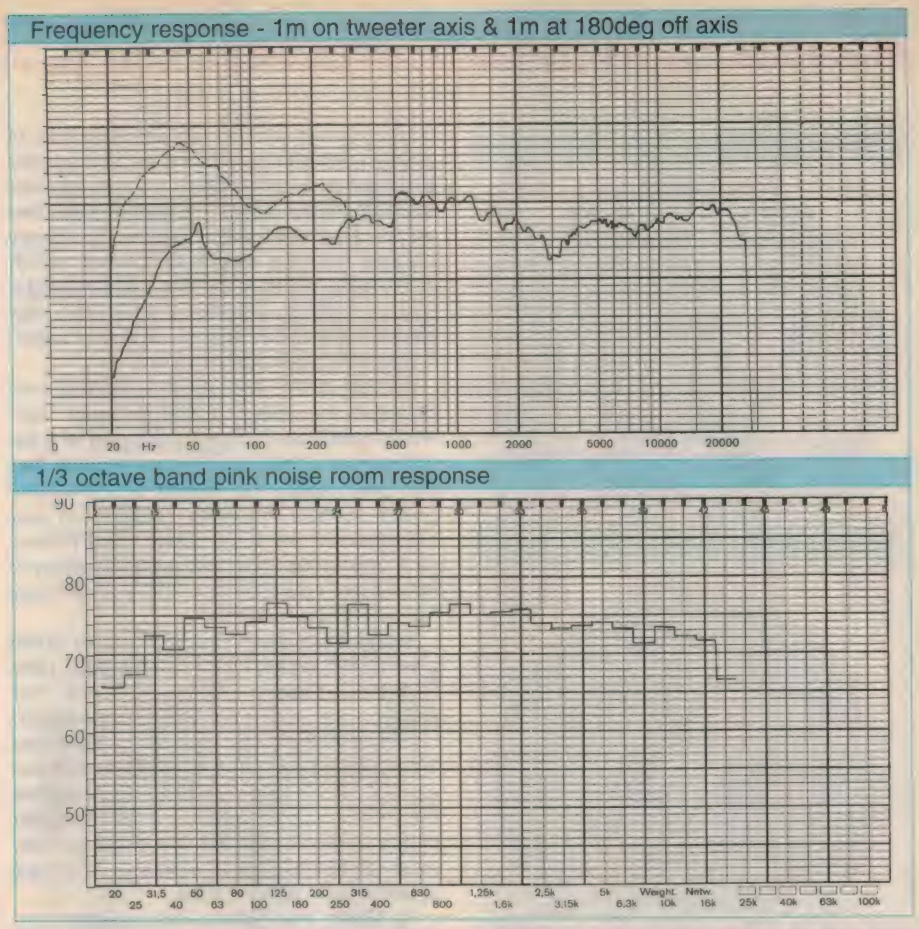
Five drivers

I detached the fancy speaker grille, and focused my attention on the five drivers located in a vertical linear asymmetric array on the front panel. The speaker configuration appears to be a rather significant deviation from Dali's normal design approach in that they have adopted a single 29mm silk dome tweeter for the top end of the spectrum, with a crossover at 4kHz.

The tweeter is flanked on both sides in the vertical plane by two 125mm mid-range drivers. The tweeter is located a sensible 950mm above the floor, as that conforms neatly to match your head position (and of course your ears), when seated.

The bottom end of the audible spectrum is handled by a pair of 200mm diameter long-throw bass drivers. These smoothly cover the frequency spectrum from 20Hz to 600Hz. The designers have adopted a 20-element crossover, which provides some degree of protection for the tweeter, but not necessarily for the mid-range drivers or woofers.

The vented speaker enclosure uses what has become a fairly common approach, rear venting. However in lieu of the normal single-venting port, Dali have adopted two 60mm diameter ports, each of which is 140mm long. The lower venting port is 350mm above the floor, whilst the higher port is 650mm above the floor. Although I have long viewed that approach as being less desirable than a front-venting port, I must acknowledge that the Dali Grand has changed my view and my stance.



The frequency response curves at top are those measured at 1m in the anechoic chamber, with the upper dashed curve measured at the rear. The lower plot is the one-third-octave pink noise response in a typical listening room.

When I finally had the Dali Grand loudspeaker correctly ensconced on the turntable in the anechoic chamber, I was able to rotate it and examine the quality of its finish. As I rotated it, I observed that the four faces and top of the cabinet are beautifully veneered. The designers have not skimped on the application of veneer, which covers all of the exposed surfaces, with the impeccable quality of Danish workmanship — equal to the best in the world.

The speaker connections are provided through two sets of surface mounted, colour coded gold-plated banana plug sockets on the rear panel. On examining the eight-page handbook, I learned that the Grands are designed for bi-wiring. The handbook forcefully states that this 'is the intended hook up configuration'. Whilst the handbook does not deprecate a single stereo amplifier with the bi-wiring, it does however strongly advocate bi-amping as the preferred configuration. The instructions go further, and caution the user against using 'bits of wire', and stresses that cable quality and design do make a difference...

Obviously, when you have spent a large sum of money on your loudspeakers, there is no justification for the manufacturer not to tell you:

Cable quality and design do make a difference. Buy the best cable you can reasonably afford. In this simple way, you can raise the performance of your system to a higher level.

During the 'A' speaker's evaluation in the anechoic chamber, I was unable to provide a bi-wired, or bi-amped configuration. I was forced to use our normal low impedance speaker cable, with heavyweight oxygen free copper (OFC) cable links. These provided interconnection between the upper and lower connection jacks located on the rear face of the speaker cabinet.

Instrument testing

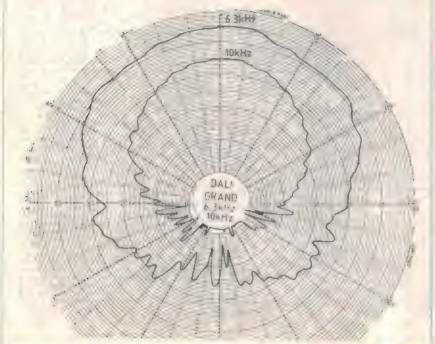
The first test I conducted was to evaluate the Dali Grand's on-axis frequency response. Whilst the response was reasonably smooth between 300Hz and 20kHz, it lacked the performance that I would have anticipated it would display between 20Hz and 300Hz.

I decided to rotate the speaker through 180° on the turntable, to measure the rearward component of sound emission, and specifically the components of sound emitted by the rear venting ports. Not so surprisingly, I discovered that the low frequency energy emitted by those two ports was significantly higher than the sound emitted by the two low frequency drivers on the front panel.

By combining the two graphs (the component from the front with that emitted from the

Polar radiation

At 1kHz and 3.15kHz



At 6.3kHz and 10kHz

back), you are able to see just what sort of energy spectrum is radiated by the speaker enclosure in a conventional semi-reverberant listening environment. The dotted upper line on the level recording indicates the energy radiated from the rear of the cabinet, which will be reflected from the rear wall behind the speaker cabinet. The lower solid curve displays the spectral distribution of energy radiated from the front of the cabinet.

Whilst there are obvious differences between the energy radiated under anechoic conditions to those measured in a listening room, there can be no denying that the Dali Grands do exhibit a remarkably broad spectral response. Indeed, if you examine the one third octave band filtered pink noise room response, you will observe how smooth the Dali Grands are all the way from 25Hz up to 20kHz.

Whilst it was sitting on the turntable in the anechoic chamber, I recorded the polar plots at 1kHz, 3.15kHz, 6.3kHz and 10kHz. For convenience, and to provide appropriate discrimination, the polar plots at 3.15kHz and 10kHz have been offset by 10dB so that you can see which trace is which, and examine the trends without confusion. All four polar plots are smooth, and the sweet spot for optimum stereo imaging lies within a +/-50° arc at frequencies up to 6.3kHz.

At 10kHz that arc narrows down to +/-25° for a +0/-3dB change in sensitivity.

In short the broad directivity characteristics of the Dali Grands are impressive, but they would clearly need to be optimally spaced and positioned to ensure good listening over an appropriate arc width within any particular listening room.

I progressed into an evaluation of the harmonic distortion characteristics of the speakers, at the normal spot frequencies of 100Hz, 1kHz and 6.3kHz. At 100Hz the harmonic distortion characteristics of the Dali Grand were acceptable at output levels up to 96dB at 1m. At higher output levels, the distortion characteristics climbed fairly rapidly.

By contrast, at 1kHz the distortion levels were remarkably low at a level as high as 100dB, and still acceptable at levels of up to 105dB. At 6.3kHz, the distortion levels are quite acceptable at 96dB at 1m. As I had no information on the type or efficacy of speaker protection provided, I was unwilling to drive the tweeters to higher levels for fear of causing damage.

The next stage of testing involved recording the decay response spectra. That testing revealed that the composite spectrum from 1kHz to 24kHz is generally smooth at high levels, and decays rapidly by typically 20dB or more before there are any signs of significant residual low level resonance characteristics. You should be able to identify the low level peaks in the vicinity of 5kHz, 6.5kHz, 8.5kHz and 11kHz. Fortuitously there were no signs of disturbing high level resonances which would be audible following transient signals.

I progressed to examining the Dali Grand's phase response, and specifically the unwrapped phase response. As you will note in the graph, the measured response is particularly smooth. It appears that the smooth response is attributable to the combined effect of an excellent crossover design, supplemented by the attributes of the speaker system's mid-range drivers and tweeter.

The tone burst tests revealed no significant transient anomalies when tested at 100Hz. There was a trace of carry-over at 1kHz and signs of detectible resonances from the tweeter drivers at 6.3kHz. That information agrees fairly well with the decay response spectra, in which there is a fairly well defined resonance at around 6.5kHz.

The input impedance curve is typical of a vented enclosure with a significant peak of 15.2Ω at 15Hz, and a slightly lower peak of 13Ω at 48Hz. The minimum impedance is 3.3Ω at 100Hz, and consequently these speakers should ideally be operated without parallel speakers if you wish to avoid overloading your amplifier's output stage. The impedance curve between 100Hz and 20kHz is relatively smooth, with the impedance lying between 3.3Ω and 6Ω.

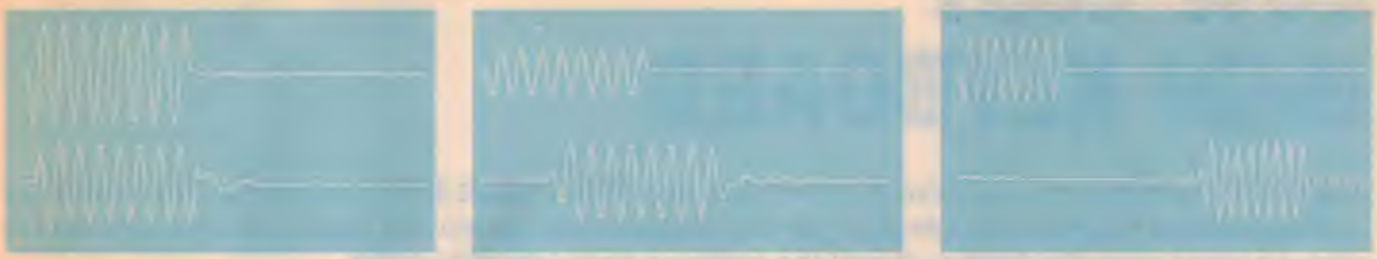
My overall impression of the objective test results was that the designers have laboured long and hard to achieve objective test performance which is generally impeccable in each of the critical areas of assessment.

Measured performance

Serial No 750006R

Frequency Response		20Hz to 23kHz +/-8dB	
(Combined results for 0° and 180°)			
Crossover Frequencies		Nominally 150Hz and 2kHz	
Sensitivity Measured at 1m		87dB for 1 Watt (into measured 3.5 ohm impedance)	
Harmonic Distortion			
(for indicated level at 1m)			
1kHz			
Fundamental	90dB	96dB	100dB
2nd	-	-64.4	-60.8
3rd	-54.7	-62.2	-59.8
4th	-63.6	-70.7	-56.4
5th	-54.3	-58.8	-56.8
THD	0.275%	0.154%	0.250%
100Hz			
Fundamental	90dB	96dB	
2nd	-49.9	-35.1	
3rd	-48.6	-34.3	
4th	-43.8	-42.2	
5th	-50.9	-41.6	
THD	0.859%	2.846%	
6.3kHz			
Fundamental	90dB	96dB	
2nd	-45.8	-45.2	
3rd	-35.7	-42.6	
4th	-52.1	-	
5th	-	-	
THD	2.737%	0.923%	
Input Impedance	63Hz	5.1Ω	
	250Hz	3.0Ω	
	1kHz	5.1Ω	
	4kHz	5.7Ω	
	8kHz	5.5Ω	
Minimum	3.3Ω at 100Hz		

Tone burst testing with signal level of 96dB SPL@ 1m



Tone burst response waveforms at 100Hz (left), 1kHz (centre) and 6.3kHz (right), with the acoustic output at the bottom in each case. All were measured at 1m with an SPL of 96dB.

Listening tests

In attempting to carry out my subjective assessment of the Dali Grand speakers, I initially experienced some difficulties, which I don't normally have. The two packaged speakers were too large to fit into the rear of my car (even one at a time). I soon solved that problem with a carrier, who of course needed assistance to move the speakers into my living room.

Once there, I discovered that I would need two additional pairs of wires over and above the four pairs that I already had, in order to be able to bi-wire the Dali Grands. That problem was resolved, although I must acknowledge placing those two extra pairs of wires as a 'permanent' configuration proved to be slightly more complex than I would have imagined.

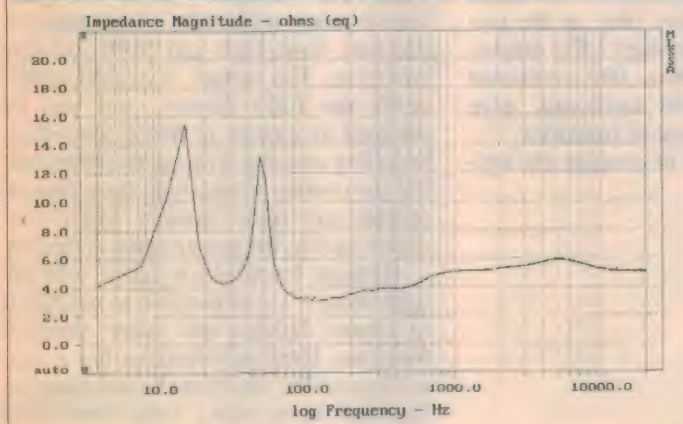
By the time I settled down in my listening position, together with my normal listening panel, we were ready to sit back and face the music. And what great music it was.

The first set of two test discs was a new 'Collectors Item' entitled *Glenn Gould Images* (Sony Classical SK 2K 62588). Glenn Gould was (and still is) one of my favourite pianists. This particular commemorative set features some strange reproductions of memorabilia associated with his life. However the beauty of these discs is that when reproduced by the Dali Grands, the piano sounds warm and real. Even Glenn's humming has a warmth, and his rendition of Bach as epitomised by the Well-Tempered Clavier and the Goldberg Variations, is brilliant.

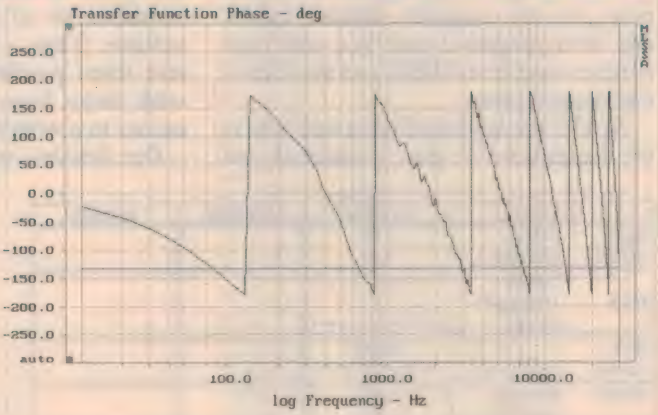
I progressed to a re-release of Rudolf Serkin playing Beethoven's 'Emperor' Concerto No 5 (Telarc CD 80065), which is one of the finest recorded renditions of that particular piano concerto which you could purchase. Again, during the A-B testing against my reference speakers, the Dali Grands performed extremely well, and I 03)

(Continued on page 22)

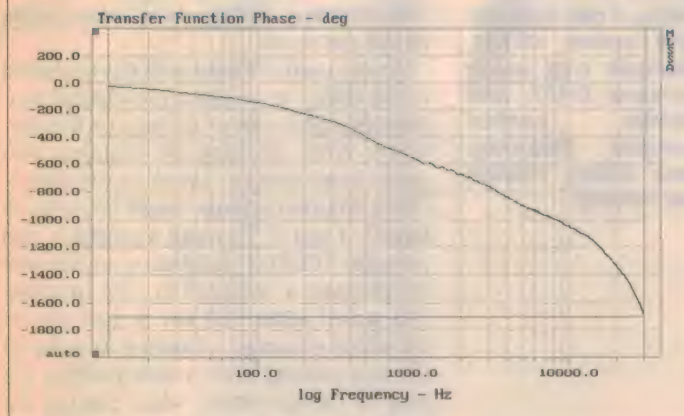
Impedance magnitude - ohms (eq)



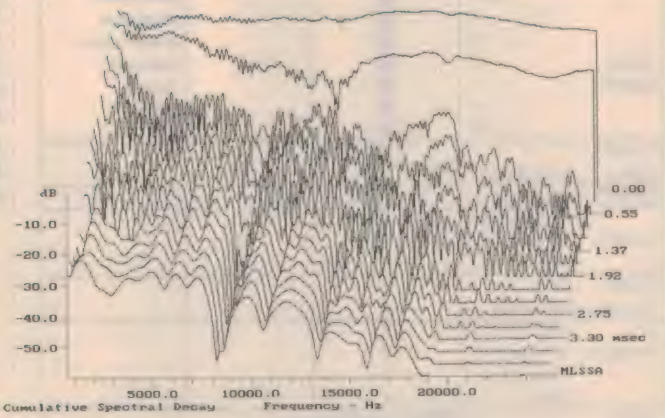
Transfer function phase - deg (wrapped)



Transfer function phase - deg (unwrapped)



Cumulative spectral decay - IEC frequencies



LOW COST MIDI KEYBOARD

The MIDI keyboard we're reviewing here costs only $80. Included with the keyboard is computer software called Popkey that lets you get into computer music via the keyboard. Although low in cost, as you'll read, the keyboard and the software have lots of features.

by PETER PHILLIPS

MIDI music has been around since the early 1980s, and since its development, a vast range of products has been forthcoming. Because MIDI is a standard, any MIDI instrument will work with all (well, almost all) other MIDI equipment. Today you can select from a huge range of MIDI-based gear, including MIDI instruments, sound generators, sequencers and, of course, computer software.

A problem for many people is cost, particularly when it comes to a MIDI instrument such as a keyboard. Generally you'll pay several hundred dollars for a modest unit, and thousands if you want all the features. A MIDI sound generator will usually set you back $500 or more, so by the time you add computer software, cables and other peripheral gear, you won't get much change from $1000, and that's for a bare-bones system.

At $80, the keyboard reviewed here is the cheapest we've seen, so naturally we were most interested to see how it performed, and what features it has. Although the keyboard will work with any MIDI system — which means you don't *need* computer software — because the keyboard comes with software, we also loaded it to see what it does. Here's what we found.

The keyboard

The keyboard covers four octaves, measures 115 x 655 x 40mm (WxDxH) and weighs 0.83kg. It can operate from batteries (six AA cells) or from a 9V DC plugpack (not supplied). The keys are not full size, nor are they pressure sensitive. That is, the keyboard is not touch sensitive, so all notes play at the one volume. It has a two-digit LED display and three pushbuttons, that combined with keys from the keyboard, give access to a wide range of functions.

Our first test was to connect the keyboard to a MIDI sound generator (synthesiser), connected via a standard MIDI lead from the keyboard to the generator. After confirming that the system worked, we then experimented by changing octaves, the sound generator voice and so on. Functions are selected by pressing the SELECT button on the left of the keyboard, then the appropriate key on the keyboard. Numerical values relevant to the selected function are displayed on the LED readout, with values greater than 99 shown with a dot representing 100. That is, 127 is shown as dot27.

Functions available from the keyboard include setting the MIDI channel (1 to 16), pitch bend, transpose (-12 to +12 semitones), octave (-1 to +2), sound generator program, bank LSB and MSB message and so on. The 'wheel' is a slider underneath the LED display, and can be assigned to a range of MIDI controllers, including velocity. You can therefore control the overall volume with the wheel, or operate any other standard MIDI controller, such as the sustain pedal of a piano.

Although intended for music, with the right setup it's also possible to use MIDI to control lighting and other electrical functions. Here each function has a controller number, which can be sent from the keyboard along with a value determined by the setting of the wheel. So with the right circuitry, you could even use this keyboard as a MIDI lighting controller — with dimming, lighting bank select, lights on-off and so on.

A very useful feature with this keyboard is the ability to assign a preselected program change to one of six keys on the keyboard. After selecting the required program, it can then be 'saved' to say, key 1. Other program settings might be saved to keys 3, 4 and 5. To recall a program, you press the SELECT pushbutton and the key the program is assigned to. The information stored under that key is then sent to the sound generator, changing its voice to the new setting. With a little practice it's easy to change voices while playing the keyboard, with virtually no interruption to

Function		Transmitted	Received	Remarks
Basic	: Default	1-16		
Channel	: Changed	1-16		
	: Default	----------		
Mode	: Messages	X		
	: Altered	**********		
Note		12-120		
Number	: True Voice	**********		
Velocity	: Note ON	※		
	: Note OFF	X		
After	: Key's	X		
Touch	: Ch's	※		
Pitch Bend		O		
	0,32	※		Bank select
	1	※		Modulation
	2	※		Breath control
Control	6	※		Data entry
Change	7	※		Volume
	10	※		Panpot
	64	※		Hold 1
Program		0-127		
Change	: True Number	**********		
System Exclusive		X		
	: Song Position	X		
Common	: Song Select	X		
	: Tune	X		
System	: Clock	X		
Exclusive	: Commands	X		
Aux	: Local ON/OFF	X		
Messages	: All Notes OFF	X		
	: Active Sense	O		
	: Reset	X		
Notes:		※:Can be set to O or X		

The keyboard's MIDI implementation chart. Among other control codes, it can transmit note codes 12-120, channels 1-16, patch numbers 0-127, and various control changes including bank select, volume and velocity.

Measuring 655 x 115 x 35mm, the keyboard has 49 mid-size keys, a small slider control 'wheel', three control buttons and a two-digit LED readout. It operates from 9V DC.

the flow of the music.

Another useful function is the 'reset all controllers', in which pressing the SELECT pushbutton followed by the 'RESET A.C.' key on the keyboard sends a reset to all MIDI controllers. There's also a general MIDI reset.

Instruction manual

The instruction manual with the keyboard has four pages, and to be honest, we took a bit of time realising (for example) that the often mentioned + and - keys are keys on the keyboard, and not the + and - pushbuttons either side of the SELECT pushbutton. These are used with the pitch bend, while those from the keyboard let you increase or decrease the displayed number.

As well, we were slightly confused when the manual referred to, for example key 6, assuming it to mean the key labelled 6. In fact, key 6 refers to the keyboard key labelled PROG, and is labelled as 6 in the instructions. The keyboard key labelled 6 is used to enter the *number* 6.

However, apart from this minor confusion, anyone with some knowledge of MIDI will soon know what to do. Once we figured out the few anomalies, we found it easy to do all the manual claimed we could. The manual includes a MIDI implementation chart, reproduced here for your information.

Popkey

This computer software comes on two disks and runs under Windows 3.11 or DOS. We ran it under Windows, and used existing drivers to interface to the keyboard via a soundcard connected to a MIDI breakout box (see *EA* February 1994). However, although we didn't confirm this, the supplied BD15 to 5-pin DIN connector lead lets you connect the keyboard to the games port of a Soundblaster sound card. This way you can use the sounds available in the sound card.

Popkey is unusual in that it doesn't appear to support MIDI. Instead it has its own format, so standard MIDI files can't be used with it. It comes with a good range of pre-recorded musical items that can be played with a wide range of styles, such as waltz, foxtrot, rock, disco and so on.

When the keyboard is connected to the computer, you can play the keyboard and record into Popkey. We didn't explore this program in any depth, as our main interest was the keyboard. But one feature we enjoyed was a demonstration of musical instrument sounds. Here you select an instrument with the mouse by pointing to a graphic of the instrument. A short description is shown on the screen and you hear a musical item played on that instrument. Of course the quality of the sound depends on your sound generator, but this feature is excellent for those learning music.

Summary

After trying it out, we think this little keyboard represents extraordinary value. It has all the essential features and will let you play or compose music, given the right software. It connects directly to a MIDI sound generator, so you don't need a computer if you already have a generator. If you have a computer with a sound card, the sky's the limit.

Although small, the keyboard is easy to play and the touch is firm yet light. Once you master the instructions, you'll have no problem getting the keyboard to send MIDI messages, change channels, voices, velocity and so on. Its versatility means it can be used in a band, at home, in schools etc. Being battery powered it's also very portable.

The software, although not MIDI-based, has many great features, and we enjoyed just listening to the pre-recorded items, as well as browsing through the musical instrument demonstrations.

In short, we found this to be an excellent package that will let anyone with a limited budget get into MIDI music. The limitations are very few when you realise that although the keyboard spans four octaves, the octave setting lets you span a total of seven — almost the equivalent of a conventional piano.

The keyboard has an RRP of $80 (including Popkey software) and was supplied for review by Oatley Electronics. For more information, contact Oatley Electronics, PO Box 89, Oatley 2223, phone (02) 9579 4985, email: oatley@world.net. ❖

Update on Digital Camera Technology:

HERE THEY COME!

Digital photography is now achieving usable image quality at an appealing price — thanks to advancing technology. And new models are coming onto the market thick and fast, largely in response to demand from business people and those who have discovered how convenient they are for sending images over the Internet. Here's an update on what's happening in this fast-moving market area.

by BARRIE SMITH

Digital imaging is maturing at an impressive rate. No, it is not the high powered software nor the mega-bucks high-end hardware that is driving the technology forward, but the arrival of (relatively) budget priced, simple to use, point and shoot digital cameras on the market.

And, unlike conventional photography, it is not demand from keen and affluent amateurs and busy professionals that is causing the rush. No, we are seeing digital cameras becoming a useful tool in the hands of business people and those who work in the education area.

These people can see basic digital cameras as a viable aid to their activities by force of their ease of use, simple computer interface and ready availability of hard copy images in colour via the inkjet printer.

As 1996 closed the newcomers included: Epson (one model), Kodak (four), Apple Computer (one), Casio (three), Olympus (two), Canon (one), Agfa (one), Polaroid (one), Sony (one). More are likely, as 'DIY point and shoot' takes on.

The day of the easy to operate, low cost digital camera that appeals — and can be purchased by all — has arrived. Silver halide consumer photography is now seriously threatened.

Taking the idea further, Casio and Olympus are promising a direct printer and other peripherals which will help remove the PC from the equation, while Sony are about to sell a printer able to process IR signals emitted from the camera.

From this point on, it is likely that attractively priced digital cameras will assume many roles: estate agents' showcards, insurance assessors' reports, school newsletters, etc — and also be invaluable in the creation of compact images for transferring by e-mail or use in WWW pages.

In short, here they come!

As 1996 closed, a comparative avalanche of digital cameras descended. The early marques gained market advantage by releasing beguilingly priced low-res models, while the latecomers, with higher-res image capability, should please quality seekers. Here's an update, with the makers in alphabetical order.

Agfa's ePhoto

Agfa's ePhoto 307 digital camera has two resolution settings — either 36 high-res 640 x 480, or 72 standard-res 320 x 240 pixel images can be stored at 24-bit quality. Image download times are 115,200b/s (Windows) and 57,600b/s (Mac). The ePhoto features several flash settings for outdoor and indoor use and a self timer. The lens is a fixed focus 4.3mm.

Included with the ePhoto are Agfa PhotoWise and Adobe PhotoDeluxe software. Agfa PhotoWise moves the images to the computer, where they can then be organised and enhanced. PhotoDeluxe (a stripped down, 'carnival' version of Photoshop) is becoming increasingly popular — it's also supplied with the Olympus cameras.

The ePhoto is supplied with serial cables for connection to both Win and Mac computers, built-in auto flash and self-timer features, 2MB of internal flash memory. Mac and Win. It's priced at $975.

Apple's QuickTake 150

The current model, QuickTake 150, has double the shot capacity of the first model on a 1MB Flash EPROM (and the shots will remain in memory for a year, even minus batteries). It also works with Windows computers and well as Macs.

Focus is fixed (a closeup lens permits shots within the 25-30cm range) and exposure is auto — along with bare bones flash. Programmed shutter speeds run 1/30-1/175 sec. The lens, an 8mm (imaging to a 1/3" CCD) is equivalent to a 50mm on a 35mm camera. Film speed is equivalent to ISO85.

The camera weighs half a kilo. You can shoot up to 32 pics at 320 x 240 pixel resolution (limited use), or 16 at 640x480 pixel resolution — both in 24-bit colour. Once copied to the Mac or Win PC the file sizes reach 30KB or

Why the rush?

Digital still cameras have arrived as a marketable commodity with unprecedented haste, due to a number of technological convergences:

1. High speed desktop computers arrived in mid-1996 from virtually all manufacturers, offering speeds to 200MHz.
2. RAM prices fell through the floor throughout 1996, making the handling of large size images a more rapid task.
3. As noted earlier, colour inkjet printers rose in quality and fell in price.
4. Low cost image manipulation application software began to appear. Prices below $200 for Photoshop 'feel-alike' budget clones made photo touchups a pleasure, not a chore.
5. Storage costs fell with the arrival of devices such as the 100MB Zip and 1GB Jaz drives from Iomega, as well as falling prices on CD writers.
6. There has also been an increase in CCD image quality — along with the availability of new algorithms making tasks such as in-camera JPEG compression a simpler task.

Above is the Polaroid PDC-2000, capable of taking images of up to 1600 x 1200 pixels. At right are two views of the Olympus C-800L, a model fitted with an LCD screen. Below is the Kodak DC50, one of the few models fitted with a zoom lens.

Above is the Fujifilm DS-220, claimed as the first camera to use a rechargeable Lithium-Ion battery. It has a dual focal length lens. Below is the Agfa ePhoto 307, a lower-cost unit which has a fixed focus lens but can take 640 x 480 pixel images.

120KB respectively; a high res file saved in PICT can reach 900KB.

Like its peers, sympathetic software can work wonders with these (relatively) tiny digital files.

The price? A recommended $995, bundled with the excellent PhotoFlash touch-up software. The street price is just over $500.

Canon's Powershot 600

The Canon PowerShot 600 can capture at 832 x 608 pixel resolution, at 640 x 480 or 320 x 240, thanks to a 570,000-pixel CCD. There is also a mono mode for text.

The camera has an f2.5/7mm lens. Flash is built in, and also a macro mode where the subject can be as close as 20cm. Equivalent film speed is ISO 100. Shutter speeds range from 1/30-1/500 sec.

An internal 1MB of memory can store up to 15 images, up to 62 via a PC card or 900 at full res on a 170MB hard disk drive. User selectable JPEG compression can be deployed. Windows compatible, its has an RRP of $1999.

Casio's QV-10

The Casio QV-10 camera uses a colour LCD viewfinder on the back of the camera. It can output an RF signal direct to a TV set or VCR. The images — totalling 96 in all — can be downloaded as digital files to a Win or Mac computer and converted to a suitable graphics format (BMP, TIFF, PICT) and transformed in any software. Going further, the device can then accept the files transferred back to the camera.

The original picture files are recorded as CAM files in internal 16M-bit flash memory, compressed as JPEG single field files. Unloaded, they are 28KB each in size, growing to 900KB as TIFF files on a Mac. The camera info claims that the 96 picture files are stored within 2MB of memory. When returning the TIFF (or whatever format you have taken them to) files, they are converted back to the camera's CAM format.

The camera has a claimed-unique capacity to be used as a source of images in conference presentations via a video/overhead projector. Image quality

is 640 x 480 pixels, producing a final printed picture of 5.42 x 4.06cm (at 300dpi). The CCD is a tiny 1/5" in diameter (250,000 pixels), imaging to a fixed focus (but selectable to two positions) lens of 5.2mm.

The exposure system is TTL centre weighted. The electronic shutter delivers a range of 1/8 to 1/4000 sec. White balance is automatic. Power is from four AA cells or from the mains via an adaptor.

WWW users are falling heavily for the Casio as a picture acquisition tool for Web page creation. Just point your Net browser in the direction of 'digital camera' and you'll be surprised at how many personal sites use pictures from the QV-10.

The price for the QV-10 is recommended $999.

Two new models were about to be released as 96 closed: the QV-30 is similar to the QV-10, but has a 4/9mm twin focal length lens, with macro, and a 2.5" LCD finder.

The QV-100 model's CCD has 360,000 square pixels creating 640 x 480 (and 320 x 240) pixel images. This camera is equipped with 4MB of flash memory, holding up to 64 'fine' or 192 'normal' resolution images. It has an LCD finder of 1.8".

The prices for these two new models had not been announced as we went to press.

Chinon's ES-3000

The ES-3000 is the first model released by this well-known Japanese manufacturer, and is impressive. Its appearance and features are almost identical to the Kodak DC50 — which is not surprising since Kodak is a major shareholder in Chinon, and apparently has the DC50 made by them. Functionally the ES-3000 appears to differ from the DC50 only in terms of internal firmware and resolution at the highest level.

The ES-3000 is fitted with a 3:1 (7 - 21mm) zoom lens, giving the equivalent of 38 - 114mm in 35mm camera format. The maximum aperture ranges from f/2.5 to f/3.8, but auto exposure controls the aperture down to f/16. Shutter speeds range from 1/16th to 1/500th second. It offers IR auto focussing with either multi-beam or spot beam, and also macro focussing at 50cm. The viewfinder is of the separate optical type.

The image sensor is a 1/2" interline transfer CCD with a basic resolution of 410,000 pixels. There's a choice of three image resolution levels: 'superfine' (640 x 480 with lossless compression), 'fine' (640 x 480 with lossy compression) and

Images comparing the resolution available from the four most commonly available consumer formats. At top left is a 320 x 240 pixel image from a camera with no built-in flash; at top right is a 640 x 480 pixel image from a camera with built-in flash; lower left is a 493 x 373 pixel image from Kodak's DC25 camera; and lower right, a 756 x 504 pixel image from Kodak's DC50. All were saved as TIF files, without processing or manipulation.

Two images taken using a Nikon Coolpix 100, emphasising its simplicity of use (and elegance as a fashion accessory?). After taking the photos, the camera is separated from the battery pack and simply plugged into a laptop PC's PCMCIA slot to transfer and view the images. The resolution is 512 x 480 pixels.

'normal' (320 x 240). The camera has 1MB of internal Flash memory, storing five superfine images, 10 fine images or 40 normal images. It also accepts PCMCIA plugin Flash memory cards of up to 16MB capacity, giving storage capacity for up to 91 superfine images or 729 normal images.

Other features include built-in flash and a 10-second timer.

Compatible with both Mac and Windows PCs, the basic ES-3000 camera is available with cables and software for $1495, or in a Bonus Pack which includes a 4MB Flash memory card for $1695.

Epson's Photo PC

The Photo PC is a Windows-only unit and weighs 310g plus four AA batteries. It is fixed focus with auto exposure. The lens is an f5.6/6mm, imaging to a 1/3" CCD (pixel count unknown). Shutter speeds vary from 1/30-1/10,000 sec. The serial interface is RS-232C. It provides 24-bit colour images (16 at 'high' resolution, 640 x 480 pixels, 32 at 'standard' — 320 x 240), which are stored in flash memory with additional memory accessible by plug-in cards (up to 8MB) allowing a possible 80 high-res pictures to be stored.

Images can be downloaded as JPEG or BMP files. When output at 300dpi the high-res images will create a 5.42 x 4.06cm print.

The recommended price? $1149.

Fuji's DS-220

The binocular shaped Fuji DS-220 uses a 1/3" 330,000 square pixel CCD capturing 640 x 480 pixel images with 24-bit colour, recorded in three quality levels using JPEG compression. The company offers a range of flash memory cards, with capacity up to 424 images. Fuji claims the DS-220 to be the first digital camera to use a rechargeable Lithium Ion battery. It has an optical finder, with an LCD accessory finder available. Video output (NTSC) is also available.

The camera has a twin focal length (5.7/11mm) lens, IR focusing, flash and a 1/4-1/4000sec shutter. ISO film equivalents are 120/240 (switchable). Macro focussing down to 12cm is achieved with an adaptor. Auto focus, auto flash, program exposure.

Dimensions are 107 x 55 x 116mm (WxHxD), and the camera has a weight of 490g ex battery.

The DS-220 is Win and Mac compatible. Price TBA.

Kodak's models

The Kodak DC20 is the company's first digital camera to target the consumer market. Eight images of 493 x 373 pixels (high res) or 16 of 320 x 240 pixels (normal mode) can be stored in Flash memory. The images are 24-bit colour and the 'film' speed is claimed to be ISO 800-1600. The weight is 110g ex batteries.

You need operate only three buttons: a power button turns the camera on/off, a

It's the software, my boy!

Early adopters who have bought, used and come away critical of the resolution levels of the early waves of consumer-level digital cameras usually express the hope that the next generation will possess higher resolution levels — and calling for larger file sizes.

If you've ever dealt with a photographic image of a megabyte or more in size, in an application such as Adobe Photoshop, you will know that current software needs some tweaking and twisting to make it sing, dance and whistle.

One answer is Kodak's FlashPix technology, soon to be offered in a new Microsoft application: Picture It.

An alliance of Eastman Kodak, Microsoft and Hewlett-Packard developed the new imaging architecture and image file format. The technology is based on Live Picture's IVUE format, a novel imaging approach that allows users to manipulate large graphic files in virtually real time.

FlashPix can operate on a standard multimedia PC with a 486 or Pentium processor, Power Mac or Mac, making it attractive to non-professional users who would like to experiment.

FlashPix's architecture uses 'linking' to access the original image data, which is stored in only one place. When an image is viewed, the computer does not have to process the whole image. FlashPix employs only the resolution level required for the selected view and monitor size. This is a digital representation of the data that is linked to the stored high resolution data.

Users can work with many images on screen without substantial memory clogs or slow performance, because FlashPix uses only the amount of data needed to fill the screen. Other applications demand three to five times the image size in RAM.

shutter button takes pictures and another button erases memory. Shutter speeds run from 1/30-1/4,000 second.

Software supplied includes Kodak Picture Easy software to transfer photos from camera to computer; Kodak Picture Postcard, which produces email 'postcards'; PhotoEhancer; Kai's Power Goo, and a presentation application — Slides and Sound. Images can be downloaded from the camera through an RS-232C port to a Mac or Win computer.

Quality is narrowly acceptable in printed form. Print size achievable is 4.17 x 3.16cm (at 300dpi). Saved as a Mac TIFF image, you're talking less than 600KB — with such a small file size you could hardly expect otherwise. But plenty of schools are happily snapping away with these. Street price is around $550.

Kodak has three other consumer digital cameras:

- The DC25, claimed to be the world's first digital camera with the ability to accept removable CompactFlash storage cards. Kodak plans to sell a card reader/writer permitting images to be exchanged between camera and PC. Supplied software is identical to the DC20.

Users view their pictures on a 1.6" colour LCD display. The camera has built-in auto flash, 2MB of internal memory to store images — either 14 or 29 pictures, depending on the resolution selected, in 24-bit color. Resolution levels are 493 x 373 pixels (high); 320 x 240 pixels (standard). The lens is an f4/47mm (35mm SLR equiv) fixed focus, 0.5m to infinity. Auto flash. Shutter Speed: 1/30 to 1/4000 second. Batteries: two 3V lithium. Film rating equivalent: ISO 800/1600. Self Timer. Mac or Win compatible.

Dimensions of the DC-25 are 130 x 71 x 40mm (WxHxD). The weight is 270g with batteries. Price: $700.

- The DC40: a higher resolution level of 756 x 504 pixels/24-bit colour makes this model a much more usable device. Many of the specs (lens, shutter) confirm the information that Kodak were the OEM for the Apple digital camera. Differences include a 4MB memory card, allowing 48 images to be stored. Mac and Win compatible.

The DC40 uses a fixed focus lens, which accepts optional close-up, wide-angle, and telephoto add-on lenses. There is also built-in flash and a self timer. It's selling at $1300.

- The DC50: Fitted with a 3X zoom lens (35mm equiv 37-111mm) and allowing three image resolution levels, this model provides a top image resolution level of 756 x 504 pixels. Built-in flash, auto focussing and auto exposure. PCMCIA cards can be plugged in to increase storage. Price $1650.

Nikon's Coolpix

Nikon has announced two models — the Coolpix 100 and 300. The former was already on sale at the time of writing, while the 300 model is due early 1997. Both offer 'photographic' features such as auto exposure, auto white balance and flash functions. Both models are slim and lightweight, and vertical in orientation.

The Coolpix 100 has a removable battery back section, allowing the user to insert the main camera unit into an inter-

Shown here (clockwise, from top left) are the Epson Photo PC; the Apple QuickTake 150 (compatible with Windows PCs as well as Macs); the new Kodak DC25, with built-in LCD screen; and the Canon Powershot 600, which takes images up to 832 x 608 pixels.

TABLE 1: Comparing the models

Model	CCD size (pixels)	Lens	Int memory	Res levels	RRP
Agfa ePhoto 307	4.3mm (NA)	NA	2MB	640x480, 320x240	$975
Apple QuickTake 150	1/3" (NA)	8mm	1MB	640x480, 320x240	$995
Canon PowerShot 600	1/3" (570,000)	7mm	1MB	832x608, 640x480,320x240	$1999
Casio QV-10	1/5" (260,000)	5.2mm	2MB	640x480, 320x240	$(NA)
Casio QV-30	1/5" (260,000)	4/9mm	2MB	640x480, 320x240	$(NA)
Casio QV-100	1/4" (360,000)	4.2mm	4MB	640x480, 320x240	$(NA)
Chinon ES-3000	1/2" (410,000)	7-21mm Zoom	1MB	640x480, 320x240	$1495
Epson Photo PC	1/3" (NA)	6mm	1MB	640x480, 320x240	$1149
Fuji DS-220	1/3" (330,000)	5.7/11mm	NA	640x480, (2nd,3rd level NA)	$(NA)
Kodak DC20	NA (184,000)	NA	1MB	493x373, 320x240	($550)
Kodak DC25	NA (184,000)	NA	2MB	493x373, 320x240	($700)
Kodak DC40	NA (380,000)	NA	4MB	756x504, 384x256	$1300
Kodak DC50	NA (380,000)	7-21mm Zoom	1MB	756x504 (3 comp levels)	$1650
Nikon Coolpix 100	1/3" (330,000)	6.2mm	1MB	512x480, (2nd level NA)	$(NA)
Nikon Coolpix 300	1/3" (330,000)	6.2mm	4MB	640x480, (2nd level NA)	$(NA)
Olympus C-400	1/3" (350,000)	5mm	1MB	640x480, 320x240	$(NA)
Olympus C-400L	1/3" (350,000)	5mm	2MB	640x480, 320x240	$(NA)
Olympus C-800L	1/3" (810,000)	5mm	6MB	1024x768, 512x384	$(NA)
Polaroid PDC-2000	NA (1 million)	11mm	40-60MB	1600x1200, 800x600	$6405
Sony DCS-F1	NA NA	NA	4MB	640x480	$3500

nal PC card drive, so allowing direct connection to the computer for uploading image data.

The 1/3" CCD of 330,000 square pixels is a progressive-scan type. Fine image resolution is 480 x 512 pixels and it has an optical finder. A 1MB Flash memory provides storage for up to 40 images (in normal mode). It has a Macro capability for shooting close-ups. Built-in Speedlight and self-timer. Shutter speeds range from 1/45-1/10,000sec. Dimensions are 60 x 152 x 33mm (WxHxD).

The Coolpix 300 has a built-in 2.5" TFT colour LCD finder. Handwritten input can be achieved using a dedicated pen. There is also an audio recording function (built-in mike and speaker), and images can be transferred to a computer via SCSI cable or viewed on a TV.

Fine image resolution is 640 x 480 rectangular pixels, and continuous shooting at 1 frame per second is possible. An additional optical finder is available. Internal Flash memory stores of up to 125 images (in normal mode). The camera has an inbuilt flash and Macro facility. Dimensions are 78 x 150 x 32mm (WxHxD).

Olympus' models

There are three new models from this innovative company — the Camedia C-400, C-400L and C-800L, all with 45mm TFT colour LCD screens. The lens is common: a five element/four group f2.8/5mm optic, relying on TTL centre weighted average metering.

The C-400 and C-400L each have a 1/3" progressive scan CCD image sensors with a resolution of 350,000 pixels. The C-400 model has a 1MB Flash memory with a shot capacity of 12 at 640 x 480 pixels (or 36 at lower res). The C-400L has a 2MB memory and can capture up to 20 640 x 480 pixel (or 80 lower resolution) images. Both are fixed focus.

The C-800L uses an interlaced 1/3" CCD with 810,000 pixels. Its 6MB flash memory can store 30 1024 x 768 pixel images (or 120 of lower resolution). This camera has TTL focusing.

Digital Camera Technology

Polaroid

Polaroid's model is way up in specs — and also in price. Probably not for your average 'happy snapper', but an interesting pointer to which way the game and genre will go when prices begin hitting earth and consumers become more educated.

The PDC-2000 model looks like a cross between a gun sight and a pair of binoculars. The front houses the optical finder and flash, while an LCD info panel is on top.

Focusing is achieved via an ultrasonic AF system; the lens is fixed and the CCD is shifted to one of 60 preset positions. The lens is a fixed f/2.8 with a field of vision equivalent to a 38mm lens on a standard 35mm camera. The standard lens can be replaced with a 17mm 'semi tele'.

The CCD has a 1 million pixels delivering two image resolutions: 1600 x 1200 or 800 x 600, both with 24-bit colour; file sizes 5.4/1.4MB respectively. Two models are offered, with 40MB and 60MB internal capacity — storing 40/60 images respectively.

The camera is Mac and Windows compatible, and it carries an RRP of — wait for it — $6405.

Sony's entry

Stirring up considerable interest is the Sony DSC-F1, likely to be on sale as you read this for around $3500. This camera offers digital input and video output and could be used as a portable presentation, as well as input, device.

The DSC-F1 has a 1.8" TFT LCD screen, built-in 4MB of flash memory, high-speed wireless IR image transfer, built-in flash, rechargeable Lithium-Ion battery, and a host of recording modes including continuous mode, which records a series of pictures at four fps. There is a buffer memory to record images prior to shutter firing — you can capture events while in standby. Also one mode divides a single picture into nine separate sections, recording in 1/30 second intervals.

The new camera uses a progressive scan, square-pixel CCD sensor capable of capturing high resolution images — 640 x 480 pixel (VGA quality, non interlaced) resolution with 24-bit colour. Up to 108 images are stored in the integral 4MB flash memory, in JPEG format.

The DSC-F1 has a built-in infrared transceiver capable of cable-less transfer of images to a suitably equipped PC or to Sony's new DPP-M55 digital colour printer. The images are transmitted at up to 1.152Mb/s.

On the way...

Not yet on the Australian market (at the time of writing, at least), but launched overseas are models from Konica, Sanyo, Matsushita, Sega and others.

So, here they come. And, if the cynics among you sense that you've somehow seen it all before, you may well be right. Some of this new crop of digital still cameras share components (not least, the CCDs) and features with the video camcorders you have seen flood our shores over the last 10 years. Notice how a few of the upper-ticket models can record sound, accept written notes, shoot at slow continuous frame rates, create split frames — and then dump the imagery and sound to a TV set or VCR.

It is also worth observing that the current crop of consumer standard DV (Digital Video) video camcorders can shoot very good quality still images, with resolution levels on a par with some of the digital still cameras mentioned above.

Do we next expect hybrid still/move cameras? Perhaps, but the small matter of storage of huge PAL video files will have to be addressed. A 1MB file of a still image is one thing — but 25 video frames per second is quite another! ❖

THE CHALLIS REPORT — 'DALI GRAND' SERIES SPEAKERS

(Continued from 13)

came to the conclusion that at normal listening levels, the bass response was faultless.

We progressed to two more difficult tests which involved the human voice, and specifically sopranos — one being an Australian, the other an American. The Australian soprano is Joan Carden, who I regard as one of our finest sopranos. As a result, I was pleased to receive a new Walsingham Classics disc entitled 'Great Opera Heroines' (WAL 8026-2CD), featuring Joan Carden and the Queensland Philharmonic Orchestra. Track 1, 'Oh My Beloved Father', track 7 'They Call Me Mimi' and track 8 'One Fine Day' are exquisite gems, and of course all by Puccini.

Whilst listening to Joan Carden, I could detect audible differences between my reference speakers and the Dali Grands. However, the Dali Grands' performance were again impeccable, and the vocals were realistic and 'true to life'. I observed that the stereo imaging was razor sharp, and as good as you could ask for. As the singers changed position relative to the recording microphones, every minor change in position was identifiable with pinpoint accuracy.

The last disc which I played was a re-release of material most of which was previously issued as analog material more than 40 years ago. The soprano featured on the disc is Eleanor Steber, who is not well known in Australia, and is now barely remembered in the USA. The material which she recorded features some of her best work from Berlioz, Bach, Handel, Haydn and Mendelssohn.

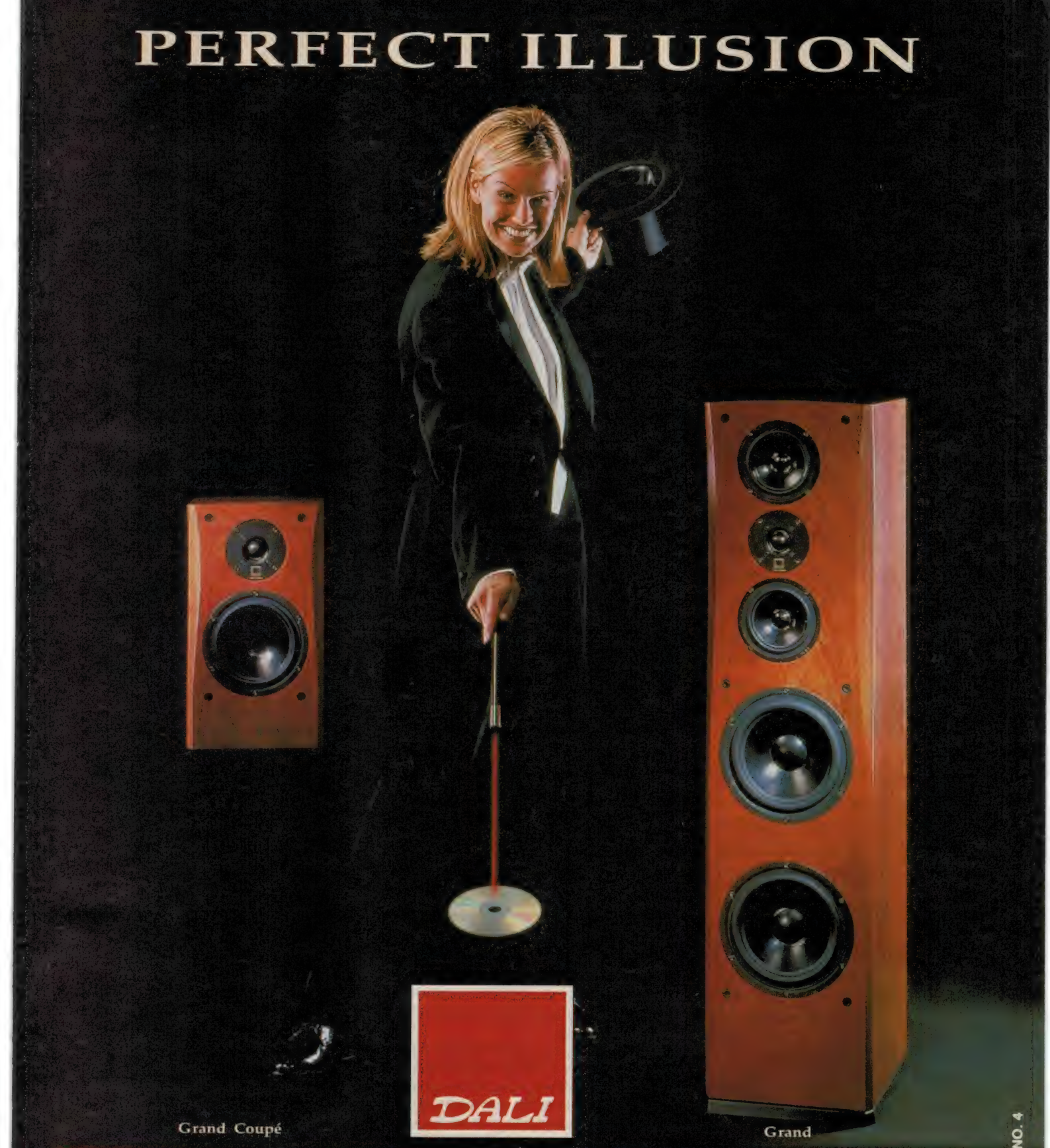
By today's standards, the recording techniques used at that time were reasonable, but not outstanding. However the music itself is what matters, and particularly Eleanor Steber's fine performances. During the A-B tests between my reference speakers and the Dali Grands, Steber's voice provided an excellent range of sacred arias, which have been remastered from the original source of material. The Dali Grands again performed particularly well, and produced Steber's high points as well as some renditions which she might have preferred not to have recorded.

The overall impression that Eleanor Steber and Joan Carden left with both the other members of the panel and myself was that the Dali Grands are 'quite grand', and provide an outstanding level of reproductive performance.

Mind you, they have an RRP of $8700, and there's only a small group of people who are able or willing to pay that sort of price for their loudspeakers. But if you're seeking unparalleled performance, matched by a set of speakers with outstanding appearance, then the Dali Grands are just what you have been waiting for.

The Dali Grand enclosures measure 1180mm high by 280mm wide and 420mm deep, and weigh 45kg each. For further information contact Scan Audio at 52 Crown Street, Richmond 3121; phone (03) 9429 2199, or fax (03) 9429 9309. ❖

PERFECT ILLUSION



DALI of Denmark has produced high quality loudspeakers for many years, using cutting edge technology to give an audio performance that thrilled those lucky enough to own a pair. With their formidable expertise in speaker design, the engineers at DALI have now produced their best effort yet with the DALI Grand and Grand Coupé.

The performance is so real that they achieve the perfect illusion...the feeling that you are actually present at the original performance, not in front of hi-fi speakers. You'd be forgiven for thinking it's magic!

DALI has a wide range of quality speakers from $699 to $36,000. For a free information kit and the location of your nearest DALI demonstration centre, please call **SCAN AUDIO** on 1 800 700 708.

Scan audio

READER INFO NO. 4

Digital cameras — a 'hands-on' report:

CHINON'S ES-3000

Judging by the number of digital still cameras that have hit the market in the last few months, 1997 certainly seems to be shaping up as the year that digital photography will 'take off' with consumers. But just what level of performance can you expect from the current technology? Here's what we discovered when we tried out the Chinon ES-3000, a model near the top of the consumer-level range and compatible with both Windows and Macintosh PCs.

by JIM ROWE

Less than a year ago, digital photography wasn't really an option for most of us. The prices for professional-level digital cameras or digital 'backs' for existing camera bodies were little short of astronomical, and even then they had a reputation for being relatively slow, insensitive and limited in tonal range. On the other hand the few 'consumer' cameras which had appeared at that stage were quite crude, and very limited in image quality. If you wanted a halfway-decent picture, you stuck with your existing film based camera.

But things have changed — and they're still changing. A new breed of digital still camera has appeared, made possible by dramatic developments in the technology of CCD image sensors, digital image processing and memory chips. Suddenly there's an almost bewildering range of cameras available, many with prices clearly aimed at making them attractive to consumers, and more are predicted to appear within months.

All the signs suggest that digital photography is set to make serious inroads in both the professional and consumer markets, and to give conventional 'silver halide' film technology some real competition at last.

But just how good *are* these new consumer-level digital cameras — how easy are they to use, and how does the image quality compare with say a traditional 35mm film camera? A good opportunity to answer questions like these came recently, when we had the chance to try out and review one of the new Chinon ES-3000 cameras.

Chinon is a well-respected Japanese camera manufacturer, with excellent connections. In fact Eastman Kodak is a majority shareholder in the firm, and at least some of Kodak's own range of digital cameras are made in Chinon's factories.

Not surprisingly there's a very strong resemblance between the Chinon ES-3000 and Kodak's own top-of-the-range model DC50. It seems that they're essentially the same basic design, but with internal firmware changes and performance enhancements fitted to the DC50 to distinguish the two.

One of the features which distinguishes *both* models from virtually all of the other

consumer-level digital cameras released to date is that they feature a 3:1 zoom lens — giving much more flexibility than a lens of fixed focal length. The zoom lens covers a focal length range from 7mm to 21mm, which corresponds to a very useful range of from 38mm to 114mm in the familiar 35mm film format.

It's interesting to note here that the ES-3000 (and very likely the DC50) uses a CCD (charge-coupled device) image sensor of 12.5mm diagonal. This is significantly larger than the 5mm or 8.5mm sensors used in most other models — which all happen to be fitted with fixed lenses. The two facts are probably related, because trying to make a zoom lens of similar range and acceptable quality for these smaller image sensors would *really* push lens technology!

Chinon's lens is a nine element, nine group design whose maximum aperture varies from f/2.5 at the wide-angle end to f/3.8 at the tele end of the range. The CCD sensor is of the interline-transfer type, with a resolution of 410,000 pixels and fitted with a mechanical shutter. Like most other sensors it produces 24-bit colour images (i.e., eight bits for each primary colour), giving a total of 16.7 million colours.

In the ES-3000 the lens/sensor focusing is controlled by a multi-beam/spot beam IR (infra-red) autofocusing system, with a range of from 700mm to infinity. There's also a 'macro' mode for taking close-up shots, at a nominal lens/subject distance of 500mm. The AF system controls the lens/sensor spacing in 100 increments, and is quite accurate. It operates when the shutter release button is pressed in 'half-way', and then locks to that setting for the actual exposure — allowing you to focus on a particular subject or object, and then pan or tilt if you wish to take the shot with a different composition. (This is a big improvement over most of the current digital cameras, which are generally fixed focus as well as fixed focal length.)

Not surprisingly there's also an auto exposure system, which adjusts both lens aperture (down to f/16) and shutter speed (from 1/16 to 1/500th second) to cope with a light range from LV7 to LV16. Light metering is via a centre-weighted CdS (cadmium sulphide) sensor, and the camera has a sensitivity equivalent to ISO 200 film.

In addition, the ES-3000 has a built-in sensor electronic flash, which can be set for auto sensing, fill flash or off modes. The flash recycling time is about 4.5 seconds with new batteries.

The viewfinder is of the separate optical type, with its axis to the left and a little above the taking lens. The eyepiece is a fixed -1.0 dioptre type.

(I guess for those of us who have been used to using an SLR camera, the return to a separate optical finder is probably the most disappointing aspect of the ES-3000 — although to be fair, just about all of the new consumer-level digitals are the same. A few have LCD-screen type finders, but frankly I'd prefer an SLR system...)

As a straight camera, then, the Chinon is quite respectable. But what about the 'digital' side of it — where electronics has replaced the traditional film?

Well, the ES-3000 can save the images captured by the CCD sensor in any of three storage modes, two of which have the same nominal level of resolution. There's 'Normal' (N) mode, where they're stored in 320 x 240 pixel format; 'Fine' (F) mode, where they're in 640 x 480 pixel ('VGA') format, but with a relatively 'lossy' compression algorithm; and 'Superfine' (SF) mode, where they're again in 640 x 480 resolution but using a lossless compression algorithm.

The camera has an inbuilt one-megabyte (1MB) Flash memory, which can store up to 40 of the low-res N images, 10 of the medium-res F images or five of the high-res SF images. However there's a PCMCIA card slot built into the rear of the case, which can accept matching Flash memory cards of up to 16MB capacity. If you augment the memory in this way, its storage capacity can therefore be pumped up to 729 of the low-res images, 182 of the medium-res or 91 of the high-res images. Even with a 4MB card fitted the figures become 212 low res, 53 medium res and 26 high res — which should be more than enough for the majority of users.

It's worth noting that the images are stored in the camera's memory/card in compressed digital format, in all three modes. This is fairly clear from those figures: a 320 x 240 pixel 24-bit colour image in uncompressed form would normally require 230KB of storage, whereas in the camera they're clearly stored in no more than 25.6KB (1MB/40). Similarly a 640 x 480 pixel 24-bit colour image normally requires 922KB of storage, but in the ES-3000 the SF images are stored in 192KB (a little less than 1MB/5).

All of the new digital cameras use this kind of image compression, in order to fit a reasonable number of images into an affordable amount of memory. Chinon's literature describes the system used in the ES-3000 as proprietary technology based on the DCT (discrete cosine transformation) algorithm.

Of course to view the images you've taken, you need to transfer them from the camera's memory to a computer and/or colour printer. To facilitate this transfer the ES-3000 is fitted with an RS-232C serial port, using a miniature 'DIN8' connector, and cables are provided to connect it to either a Windows-type PC or an Apple Macintosh. It also comes with software for either type of computer, to transfer the images and also allow them to be viewed on screen, printed out or fed into any of the popular image manipulation packages. Image transfer over the RS-232C serial cable can be at up to 56kb/s.

A sample 'SF' image taken with the Chinon ES-3000, with a resolution of 640x480 pixels and lossless compression. It has been converted to CMYK format for printing, but otherwise unprocessed.

(It's also possible to use the PCMCIA memory card as a transfer medium, if your desktop PC or laptop is fitted with a card slot. Chinon provides the software for this, too.)

The ES-3000 is powered from four AA-size alkaline or NiCad cells, which fit inside the case at the side rear. (A set of alkaline cells is rated to last for about 300 shots, if the flash is used for about half of them.) The camera measures 150 x 116.5 x 62mm (D x W x H), and weighs 520g without batteries. It's fitted with a standard 1/4" tripod socket.

Trying it out

Chinon's Australian distributor Dataland very kindly loaned us an ES-3000 camera for a couple of weeks, so we could try it out for ourselves. It came in their 'Bonus Pack', which comprises the camera itself, cables and software for both PCs and Macs, manual and also a 4MB Flash memory card to boost the camera's image capacity.

We tried the camera out in a variety of situations and taking a range of different shots, and generally found it very 'friendly' and convenient to use.

Half of the case front (the half with the flash) slides outward to turn on the camera's 'power', and in the off position protects the viewfinder optics and a couple of the sensor windows. If you leave the slider in the 'on' position for more than 60 seconds without using the camera, the power is automatically turned off to protect the batteries.

Driving the camera is very easy, as there are only six controls in all. On the top there's the three main control buttons: the all-important two stage shutter release, and the usual pair of buttons to adjust the zoom lens and compose your shot.

For adjusting all of the camera settings, there's another trio of three smaller buttons at the lower rear of the case, just below a small LCD display panel with a range of function icons and numeric readouts. Two of the buttons are used to perform most of the setting adjustments, with one a 'Mode' control which cycles you around the various icons, and the other a 'Select' control to choose the individual option you wish. The third button is marked 'Erase', and is self-explanatory: when it's pressed, the ES-3000 wipes any images you've taken from memory and readies itself for capturing some more.

There's also an Eject button, used purely to remove the PCMCIA memory card when one is fitted.

Apart from the LCD display, there's only one other 'indicator' on the camera: a small green LED fitted into the viewfinder eyepiece ring. This is mainly used to indicate the operation of the camera's auto focus system; when you press the release button down to the half-way position, the LED flashes and then lights continuously when the AF system has locked to a setting. Then when you press the release down fully to take the shot, the LED flashes again for a few seconds — while the camera is processing the image and storing it in memory.

Back on the LCD screen, there are two numbers displayed. The larger of the two, in the centre, shows how many shots remain available for storage, at the currently selected image resolution. The smaller number at lower left shows how many shots you've already taken. As you take shots, one indication decrements and other other increments.

Other indications on the LCD show the state of battery charge, the current image resolution, the autofocus mode, whether the auto timer is activated and so on. It's all quite intuitive.

We installed the Windows version of Chinon's software, on a 90MHz Pentium machine. There's an image acquisition utility expressly designed to work with the ES-3000, a matching TWAIN driver and a copy of Microsoft's Video for Windows Run-Time Module, which the utility seems to need in order to display the images it 'sucks up' from the camera. All installed very smoothly from the supplied floppy disks. (There's also an image manipulation package called ArcSoft Photo Studio in the Bonus Pack, but we didn't bother installing this as we had both Picture Publisher V5.0 and Adobe Photoshop V3.0 installed.)

Using the image acquisition utility turned out to be very straightforward, and generally quite intuitive. When you fire it up it seems to find the camera fairly easily, if the latter is connected up to a serial port and turned on. The camera LCD then displays a 'rotating arcs' pattern to indicate that the computer has taken over control, and unless you've configured the software otherwise, it immediately proceeds to retrieve 'thumbnail' copies of the first four or five images in the camera's memory. You can then click the mouse cursor either on any of these thumbnails to retrieve and display the full image concerned, or on a slider bar to fetch some more thumbnails...

Once any particular image is retrieved, it's displayed — although still in a fairly small window. If it looks promising, it can easily be saved on disk in standard TIF format, Windows DIB (device independent bitmap) format or in Chinon's DCT compressed image format. Needless to say if you choose the latter you can always open it again later and resave again in TIF or DIB formats.

Once saved in TIF or DIB format, you can of course open the image using a standard image manipulation package like Photoshop or Picture Publisher, and then save it again in a wider range of formats including JPEG. We did quite a bit of this during our evaluation of the ES-3000, and

Another image from the ES-3000, again in 'SF' format. Like the first, it has been a little over-enlarged to give a better idea of the resolution. (Thanks to Magdaline Youssef for being our model.)

encountered few problems.

We did find one little shortcoming of the image acquisition utility, though. When you're saving an image to disk, it gives no indication of progress; you have to watch the hard disk activity LED to tell when saving has been completed. A 'bar graph' progress indicator would be a nice improvement, or even a little 'hour glass' icon...

We found the time taken to retrieve a typical SF image (640 x 480 pixel resolution, lossless compression) from the camera and 'decode' it for display on the screen was 50 seconds. The time then taken to save it as a standard 930KB 24-bit TIF file was a further 15 seconds.

By the way, the image acquisition utility can also be used to adjust all of the settings on the camera, when the latter is connected. You can even set the camera's internal clock and calendar, which can't be done on the camera itself. (The time and date are stored as part of each image's information 'header', and until I found out how to set the date/time, I wondered why all the shots I took seemed to have been taken long before the camera was manufactured!)

We tried printing out some of the images on typical ink-jet printers, like the HP 660C and the Epson Stylus Pro, and the results were quite impressive.

Picture quality

How then can we summarise the actual picture quality? Well, after experimenting with the ES-3000 quite a bit, my reaction is that shots taken at the lowest 'N' resolution (320 x 240) are really only suitable for specialised applications like small pictures in Web pages, or tiny product shots in low-cost advertising handbills. This comment would apply to this image resolution as offered by *any* of the new cameras, of course.

But the 640 x 480 images (especially those taken in the lossless-compression SF mode) are a different matter. My impression here is that the ES-3000 takes shots that are basically about as good as you're likely to get, at this resolution level. That combination of Chinon's nine-element zoom lens, 12.5mm/410,000 pixel CCD sensor and lossless compression technology really seems to pay off...

Make no mistake, either — good 640 x 480 pixel 24-bit colour images are very practical, for a lot of applications. For the vast proportion of ordinary family photography, they're quite capable of capturing more than enough detail and subtle colour gradations. In my opinion they'd also be entirely satisfactory for 'serious' business applications like real estate property shots, police and forensic imaging, medical and insurance documentation, fast capture of news and personality shots for DTP newsletters, capturing personnel images for company databases and ID badges, images for sales presentations and so on.

A rear view of the chinon ES-3000, showing the LCD screen at upper right, the viewfinder eyepiece and AF indicator LED, and a partly inserted Flash memory card.

Compressed into JPEG form, they're also excellent for sending 'snapshots' around the world as e-mail attachments over the Internet. Tom Moffat and I exchanged shots in this way while I was testing the ES-3000, and we were both delighted with the results.

Frankly my impression is that the ES-3000's SF images would even be suitable for reproduction in magazines like *EA*, providing they were reproduced no larger than single-column width (or at most about 88mm wide, in an emergency). So in terms of image quality, it would be fine for taking small product and people shots. Hopefully this will be evident from the sample shots I've taken, as reproduced in this review.

Mind you, I have to add that for someone like myself who has become very used to using an SLR camera, going back to a separate viewfinder model does seem like a very retrograde step. But in writing this I'm aware that just about all of the first generation of digital cameras have the same shortcoming. At least the ES-3000 does have a zoom lens, and one that focusses as well!

I guess what I'm saying is that Chinon's ES-3000 compares very well indeed with the other consumer-level digital cameras that have appeared to date, and is quite capable of taking very satisfying pictures. But I for one am still waiting for Mr Chinon, or one of his competitors, to come up with a model featuring a through-the-lens SLR type viewfinder — and preferably also optional manual over-rides for the focus and exposure functions. If they can offer us such a model, perhaps with a higher image resolution mode as well (say 1024 x 768 pixels, or even better 1224 x 1024), I'll be swinging over to digital immediately. I'm sure I won't be alone, either. Cameras like the ES-3000 demonstrate that the era of digital photography has well and truly begun, in earnest.

In the meantime, Chinon's ES-3000 should do very well. Especially at the prices quoted, which seem to offer good value for money in a comparative sense. The basic ES-3000 with cables, manual and software for both Windows and Mac computers has an RRP of $1495, while the Bonus Pack with added 4MB memory card (usually around $500 in itself) is only $1695.

Further information on the Chinon ES-3000 is available from Dataland, of 212-218 Johnston Street, Collingwood 3066; phone (03) 9416 3355, or fax (03) 9416 3925. Our thanks to Dataland for making a review sample of the camera available to us. ❖

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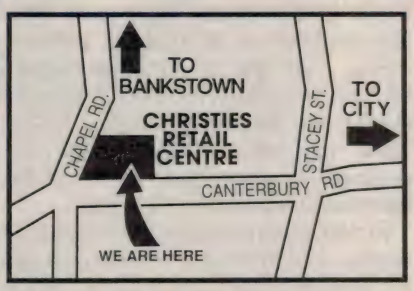

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WALL-TO-WALL INTERNET

If there was ever any doubt about the current major obsession in the world's computer industry, it was dispelled by the latest COMDEX computer show in Las Vegas. As our US correspondent reports, almost all of the 2100 exhibitors went to great lengths to show how *their* products were designed to improve life on the Internet and World Wide Web. Other new technology and products did get a look-in, though — like DVDs, Microsoft's new Windows CE operating system and Mitsubishi's 'artificial retina' chip.

by PAUL SWART

Despite all of the hype, the 1996 COMDEX FALL show held in Las Vegas produced few if any earth-shocking products or technology announcements, with the possible exception of Microsoft's new Windows CE operating system for hand-held devices. Most of what was hot at COMDEX involved products or technologies that had been introduced during the past year.

In fact, you really have to wonder why anyone *would* make a serious new product announcement at the show. Chances are any kind of news that fell short of earth shattering would get lost in the sea of some 10,000 new product announcements. In addition, exhibitors want the visiting retailers to be aware of their latest wares *before* they arrive in Las Vegas, where many purchasing decisions are made. Learning about a new product that close to Christmas would have been too late.

Rather than a place of revelation, then, COMDEX functions as a huge gauge for market and technology trends. As much as multimedia was the dominant factor in the 1994 show, this time the Internet and World Wide Web were the key buzz words on the floor — with just about every company trying to show the 'Internet readiness' of *their* products and platforms.

All the same, a record number of new products and technologies were on display, and a record 215,000 visitors jam-packed everything but the casinos. This show brought so many hot new mission-critical technologies together under one roof, many visitors and analysts worried that the information required to make intelligent PC, networking, operating system, and Internet decisions may become overwhelming for most businesses and consumers.

More than 2100 companies exhibited their wares. Together they displayed a whopping 10,000 new products, an average of 250 new products for every hour of the five day-event.

The Internet industry

Even industry leaders such as Microsoft and Intel appear to have become mere

One of the DVD players being demonstrated at Comdex was this model from Panasonic, the DVD-A300. Many were surprised that DVD took a backseat at the show, eclipsed by Internet products.

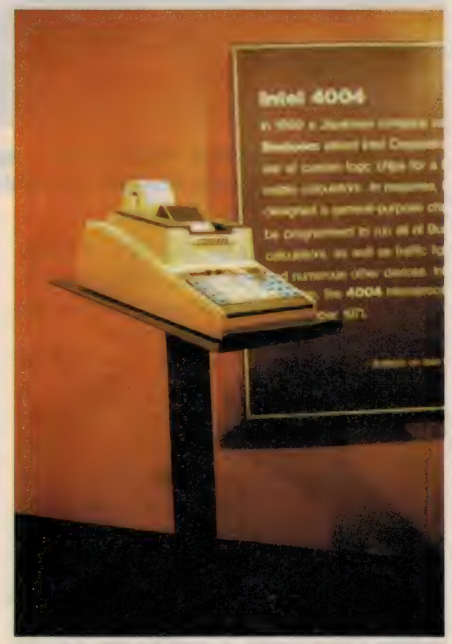
planets orbiting the all-powerful Internet. "There's almost no booth at COMDEX where you're not seeing rich Internet things going on", observed Microsoft chief Bill Gates, in his keynote address to an overflow crowd of 9500 people. All the same, he spent a large portion of his 70-minute address discrediting network computers, Java, Netscape browsers, and other challengers to his company's monopolistic view of the PC world.

"The PC will gain power, not lose it, in the age of the Internet", Gates argued, taking a stab at predictions that inexpensive diskless NCs will become a mainstream computing product.

No fewer than 550 dedicated Internet companies exhibited at COMDEX, twice as many as a year ago. Meanwhile, the majority of the other 1500 exhibitors went to great length to demonstrate how Web-ready they are. Even a battery company was saying it had a way to make laptops run longer on the Internet.

The Internet will support a huge range of connected devices, especially telephones, said Gates — whose company announced it has made an investment in the WebTV company. "The Internet will popularise 'subsets' of the PC, such as handheld PCs, and new ways of accessing Internet information, such as using a TV set with Internet browsing capability", he added.

Meanwhile, on the hardware side of the industry, Intel chief Andy Grove declared war on the television world, and presented a technology roadmap that will result in microprocessors which, by the year 2010, may contain one billion transistors and process data at 10GHz. They will power personal computers that can offer consumers 'life-like' interactive computer experiences. "We are in competition for these consumers, for their dollars and their leisure time. That competition is the TV," Grove said.



Tens of thousands of Comdex attendees visited the microprocessor museum, at which was displayed the Busicom calculator for which Intel designed its original 4004 micro.

533MHz PowerPCs

To compete effectively, Grove argued, will require powerful machines that display life-like visuals and audio. A big step in that direction were several Macintosh computers on display in the PowerPC consortium exhibit. The machines were built around the 533MHz PowerPC-based chip that was introduced just three weeks previously by Exponential Technologies in San Jose.

Machines using the Exponential chip will be available in early 1997. An Exponential official predicted his company would have a 1GHz microprocessor chip on the market in the next two to three years.

In contrast with the multitude of forward-looking discussions at the show, the 18th COMDEX also offered an uncharacteristic touch of nostalgia with a look back on the past — because the show commemorated the invention of the microprocessor in November 1971. Tens of thousands of visitors paid a visit to a special microprocessor museum, which offered visitors a look at some of the product and technology highlights of the past 25 years of microprocessor development, starting with the Busicom calculator for which Intel developed the original 4004 processor chip.

Noticeably absent from the list of sponsors of the museum exhibit, which included Intel and Motorola, was Texas Instruments — which co-invented the microprocessor in 1971, but has had little or no success commercializing the technology.

"When people started, they didn't have any idea how magnificent the ride would be — or the run", said Jeff Weir, spokesman for the Semiconductor Industry Association. "A sense of legacy wasn't part of the mix then."

Philips displayed the Magnavox WebTV terminal, which is identical to that launched by Sony. A set-top box, it allows TV viewers to 'surf' the Internet and World Wide Web.

Comdex 1996:

DVD players

While there was no shortage of new technologies coming into focus at Las Vegas, one technology that had been expected to steal the show, digital video disks (DVDs), was largely absent. Because a standard for encoding DVD software had only been agreed upon a few weeks previously, the machines are not expected to show up in retail stores until the first quarter of 1997.

Several DVD manufacturers showed off DVD players, including Sony, Philips, Panasonic, Samsung, Toshiba and Pioneer. But the DVDs clearly took a back seat to companies touting Internet-related gear. Toshiba announced that it would delay shipment of its DVD machines until 1997.

While DVDs will play an important role in the future personal computer market, the general consensus among data storage industry executives was that DVDs are highly unlikely to meet predictions that they will replace floppy, magnetic and magneto-optical drives. The performance of the drives, particularly data transfer rates, will remain far below that of more traditional storage devices. Also cost-per-megabyte will not likely be competitive, as hard disk drive storage capacities are starting to approach the four-six gigabytes of DVDs.

Instead, DVDs will probably replace CD-ROMs as the medium to bring programming with high entertainment and educational value to the PC desktop. Future rewritable DVD disks may also offer back-up storage functions.

On the software side, Xiphias unveiled its DVD-ROM encyclopedia, while Activision demonstrated clips from DVD games based on two of its existing CD-ROM titles, *Spycraft: The Great Game* and *Muppet Treasure Island*. Various authoring tools — such as software packages to compress digital audio and video — were also being demonstrated.

One of the speech recognition systems on display was the Philips Speechmagic system, suitable for use by medical professionals.

To PC industry insiders the lack of emphasis on DVD home players at COMDEX came as no surprise. "This is a PC show", one industry analyst observed.

Another technology that is finally showing great promise of becoming a mainstream application, after two decades of frustrated effort, is speech recognition. More than a dozen companies, from IBM to Philips to Voice Pilot, showed products ranging from voice command over various PC functions, to dictation. Even Bill Gates alluded to speech recognition, saying the technology is destined to become a key component of future computer user-interface technology, provided computers can be taught to understand the meaning of speech, not just recognize it.

Windows CE

Another hot item at COMDEX was the handheld PC based on the Windows Consumer Electronics (CE) operating system, which Microsoft launched at the start of the show. Just about everywhere you went, people were showing off the handheld Windows CE-based PCs they had just purchased or introduced.

Windows CE is a scaled-down version of Windows 95 that eliminates a lot of power-intensive functions that reduce battery life in portable devices. Microsoft helped kick off the interest in CE-based PCs by distributing hundreds of machines based on the VELO handheld computer from Philips to members of the media.

The new generation of handheld devices offer up to 40 hours of continuous use on just two AA batteries. While their small keyboard makes them unsuitable for extensive wordprocessing, travelling professionals will appreciate being able to perform spreadsheet, database, e-mail, and other functions on the road using the same user interface they're familiar with on their office or home PC.

Bill Gates said as many as 90 companies would have CE-based systems and software titles on the market by Christmas. Philips, Casio, Compaq, H-P, LG Electronics, Hitachi, and NEC were among the first to get out of the CE starting gates...

While they may prove useful in some applications, such as reading e-mail, spreadsheet and database processing, the keyboards are so small you need a pen to help with the data input. And the screens

PCs head for home...

Whatever happened to the PC business market? About the only phrase I heard throughout the COMDEX show was "consumer market".

1997 is expected to be the year the PC market will officially become a fully-fledged consumer product, a move driven by virtually every major company in the business. And for the reason that over the past four years, consumers have apparently indicated that they are ready, willing, and financially able to embrace the PC as the information appliance of the future. Since there are far more consumers than businesses, industry players have voted with their feet and the resulting stampede is headed for Main Street, rather than Wall Street.

One of the strongest drivers behind the consumer PC drive is Intel. As company president Andy Grove explained, the only way Intel will be able to afford to build the US$10 billion microprocessor Grove foresees around 2010 is to vastly broaden the market for PCs. That will not be possible unless Intel can get hundreds of millions more consumers to get hooked on the Internet, or whatever other popular PC uses may catch their fancy.

Philips scored highly at Comdex with its VELO handheld computer, using the new Windows CE operating system. Microsoft liked it so much that it distributed hundreds to media representatives...

are so darkened in order to preserve energy, you need some very sharp eyes to be able to work with the devices for more than a few minutes!

Marketers were quickly predicting sales volume of more than six million units a year by the turn of the century. That may prove a bit optimistic, unless the display industry comes up with better displays with a minimum of additional drain on the batteries.

Also impressive were the 56-kilobit modems launched by various companies at COMDEX. The future of Internet communications, however, appears to be with the 10Mb/s access which TCI and other cable companies have started to offer consumers at prices of around US$30-40 a month.

Voice recognition is fast becoming a mainstream PC application. Every Star Trek fan fondly remembers how engineer Scott expected a Macintosh computer, in the 1986 *Star Trek V* movie, to respond to his voice commands. Today, PCs will be able to understand a wide range of verbal commands and even take dictation using products from Grundig, Philips and at least two dozen other large and small companies. Most visible was Voice Pilot, which is using licensed IBM speech recognition technology to enable users to enable verbal wordprocessing.

Microprocessors and memory chips are not the only products following Moore's Law, in which performance doubles every 18-24 months. Disk drive makers continue to rapidly increase the storage capacity of their drives. Based on the 1996 show's offerings, PCs will soon come standard with 2-to-4GB drives.

CD-ROMs are also on a technology tear. After increasing speed from just 2X to 8X in less than three years, several companies showed 16X drives — with promises of 20-to-30X products expected to become available in the next couple of years.

MMX and USB

For consumers, 1997 will probably turn out to be one of the most confusing in recent memory. They will be asked to add a long list of new technology terminology to the already bloated list of high-tech acronyms. Consumers only just getting the hang of DRAMs, SRAMs, VRAMs, CD-ROMs, VR, PCM-CIA, PDA, ISPs, URLs, and the like, will now be asked to start understanding the advantages of MMX and USB — two of the hot new technologies that will directly influence how computers will be used in the future. "A big wave of new technology is coming to market in 1997", said Eric Lewis of International Data Corp.

Those COMDEX parties...

Few trade shows in the world attract more media than COMDEX. The fact that the show offers some of the most elaborate parties in a town known for extravagance certainly plays a major role.

So elaborate are some of the COMDEX parties that an entire Web site was dedicated to what went on there, and what was being said in the after-COMDEX social events.

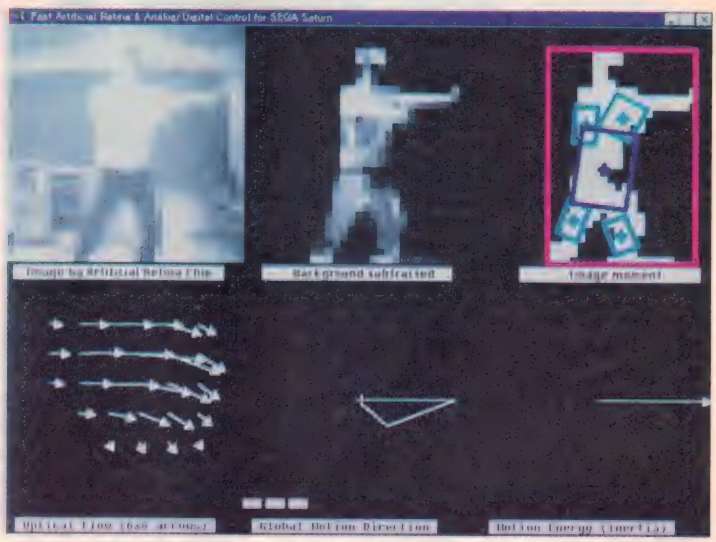
Two of the hottest parties of the 1996 show took place at the house of the late piano showman Liberace, and atop the new 1300-foot Stratosphere tower — where Apple hosted a $250,000 press party.

The Stratosphere offers not just spectacular views of Las Vegas and the surrounding desert; it also sports two of the most hair-raising thrill rides ever conceived, including a roller-coaster ride atop the roof of the Stratosphere's restaurant on the 108th floor.

If the roller coaster isn't exciting enough, with nothing but 1000 feet of air between you and the Vegas Strip below, you can try the *other* attraction: the Big Shot. Strapped in one of 16 chairs surrounding a skinny metal tower reaching another 300 feet into the air, riders are propelled skyward at a force of three-to-four Gs. This is enough to reach the top of the tower in about 1.3 seconds, and you subsequently free-fall straight back to the starting point. Apple executives were passing out free ride tickets to anyone willing to try.

DVDs will of course enable PCs to display motion-picture quality video, provided the system has surround-sound chips and uses Intel's new MMX multimedia chip technology that will be launched early in 1997. MMX adds 57 new instructions to the Pentium instruction set, to

Top: Digital cameras like this Fujifilm DS-7 were a hot item at Comdex, and sales are expected to explode. Right: Ask claims its Impression 8300 video projector is the first to use the Texas Instruments Digital Light Processing (DLP) technology, based on nearly one million pivoting micromirrors on a chip. It carries a price tag of around US$11,000.



At the show Mitsubishi demonstrated its 'Artificial Retina' unit, which can sense and interpret movement in what it 'sees'. It was being used with a video game, and effectively turned the player's body into a 'joystick'.

enhance the multimedia experience the chip is capable of. MMX processors promise to zip through 3-D and other multimedia software as much as 60% faster than current non-MMX-based Pentiums.

Intel officials said MMX will be incorporated in all of its processors by the end of 1998.

USB, which stands for 'universal serial bus', while not as glamorous as DVD and MMX, will nevertheless be an important improvement. It will enable users to hook a broad range of devices — from joysticks and keyboards, to printers and monitors — up to a standardised USB socket. USBs will even allow for 'extension cords' that connect to an inexpensive 'hub' with up to four USB sockets. Thus users won't have to worry when they run out of sockets to hook up new peripherals to their machines. They won't have to reboot their machines every time they want to add a device, either. Many peripheral makers boasted the USB compatibility of their devices at COMDEX.

Artificial retina

While there were many new technologies demonstrated at COMDEX, none came anywhere close to the level of excitement experienced by those who tried out Mitsubishi's Artificial Retina video game control system.

In a sense, with this system the player *becomes* the remote joystick, using appropriate body motions to control the movement of characters on the screen. Run (in place) and your 100-metre hurdle racer on the TV screen starts running. Run faster and it will run faster. Move your stretched out arms up-and-down as if flying, and the mermaid you are controlling 'flies' through her underwater obstacle world.

Clearly Mitsubishi has hit on the missing link in interactive computing and video gaming. The company's inexpensive (about $20) artificial retina chip promises to extend the video game experience way beyond improving hand-eye coordination. It will become physical work. Most who tried games such as the 100m hurdle racer quickly wore out physically...

After all, if you want your runner to win the race, you'd better make a lot of running and jumping motions. Imagine how long you can keep up with Super Mario as he runs and leaps his way through traitorous worlds!

Where the money went...

That COMDEX is one of the most expensive ventures in marketing history is well known. Apple spent a reported US$250,000 on its press party alone. Booth space this year averaged US$45 per square foot. By comparison, the highest priced office space available in the world — in New York, Hong Kong, and Tokyo — goes for about US$25 - 35/ft^2.

With 1.35 million square feet of exhibit space, COMDEX's owner, Softbank, raked in nearly US$60 million in floor space rentals alone.

The artificial retina chip was developed at Mitsubishi's Advanced Technology R&D Centre in Japan and the Mitsubishi Electric Information Technology Center in the United States. The intelligent human-interface system directly detects the player's body motions and translates them into the character's actions on the game screen.

The artificial retina chip is a novel image sensor which recognises the simultaneous functions of image acquisition and feature extraction, in a manner similar to the human eye. It performs flexible and high-speed (less than 1ms) feature extraction of the input image, also performing the edge extraction and image projection from 2D to 1D.

The artificial retina module consists of the artificial retina chip with an array of 32 x 32 pixel core circuits and a 16-bit microcomputer. The real-time vision algorithm is based on the image moments (simple sums of products of pixel intensities and their coordinates) and the optical flow (moving direction and speed of the image.) Using the feature image extracted by the artificial retina chip, it recognises the player's body motions with high-speed and high accuracy in the microcomputer. The real-time vision algorithm has the advantages of requiring only limited computing power and of being little affected by background.

Besides games, the artificial retina chip may have major applications in the market for aids for the physically disabled. A simple hand gesture will enable a handicapped person to turn lights, the TV, a stereo, or water on or off. It will help them use a speaker telephone, and so on.

In addition to games, the technology could be used in combination with virtual reality programs. The chip would allow a player to run an obstacle course, paddle a raft or canoe through the rough waters of the Colorado River, just to name a few applications.

Mitsubishi officials said that they are talking actively to a number of companies who may be able to develop consumer products, the first of which could be on the market before the end of 1997. ❖

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		Normally	January
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GATES & GROVE TALK ABOUT THE PC'S FUTURE

Two of the personal computer industry's heaviest of heavyweights, Intel's Andy Grove and Microsoft's Bill Gates, delivered keynote addresses at the 1996 COMDEX FALL show which offered a clear insight into what the 'Wintel' camp sees as both the hardware and software future for the US$150-billion PC industry.

by PAUL SWART

Bill Gates spent a great deal of his 70-minute speech, broken up by only a few cute videos, defending Microsoft against the voices of doom that have been raised in recent months with the heightened interest in alternatives to the Windows-based operating system world. He also outlined a number of the evolutionary changes we can expect in PC technology during the next couple of years.

Grove, on the other hand, painted a clearly defined roadmap of how Intel will get to the year 2011 — when he foresees building US$10 billion chip fabs that will produce microprocessors containing one billion transistors, and operating at 10 gigahertz. "That is equivalent to putting 100,000 DEC VAX1180 computers onto a single chip. Those machines had one megabyte of memory. They were as big as a refrigerator, and were considered state-of-the-art when they were introduced", Grove reminded his audience of more than 7000.

Grove explained that putting 10GHz chips into the hands of consumers will be required if the personal computer is to achieve its ultimate goal of displacing the television as the main medium for entertainment. "Consumers will have a choice between looking at the TV or interacting with the PC. We are in competition with the TV, for consumers — for their dollars, and their leisure time. While new PCs will outship new TVs on a worldwide basis for the first time this year, we have a long way to go before we win this war of the eyeballs. In this war, he who captures the most eyeballs wins", said Grove.

Currently, television is the clear winner for offering an evening's entertainment. While the PC, with the assistance of the Internet, offers a lot of information, most video on PCs is still jerky and fuzzy. The playing field will level up next year, Grove said, when PCs will offer broadcast-quality video, using a PC running MMX-based Intel processors and hooked up to a DVD player.

Grove showed a prototype of such a

Microsoft's Chairman Bill Gates: "The PC will become MORE powerful, not less..."

combination using clips from the movies *Twister* and *Space Jam*, and compared them to the quality of current high-end PCs. The difference was rather overwhelming.

Asked what would happen to the battlefield if new high-definition digital TVs were to become more interactive, Grove said. "This is going to sound awfully arrogant, but I think when it comes to digital TV, the television industry is trying to play catch-up with the capabilities that are readily available in personal computer technologies."

On another level of entertainment, which Grove calls "visual computing", the PC today is only at about the 1-2% level of matching the television in creating what Grove calls an interactive 'real life experience'.

Grove used three generations of computers to demonstrate the point. Using the same complex 3D graphics database in which the viewer takes a 'stroll' through an artificially created country village, the first system, representing today's Pentium-level technology, showed little detail or 3D realism. The second level, powered by a P7-level chip provided a much smoother 'ride', while the third system, using the equivalent power level of 32 PentiumPro chips, provided rich graphics, natural motion, highly impressive graphical detail, high-quality sound effects, and panning capability.

Still, even at this level, Grove said, personal computers will have reached only about a 40-50% of the real-life interactive experience, leaving Intel and the rest of the semiconductor and computer industry with several decades worth of additional technology development.

"I am convinced we can do it. After all, in just four years we went from postage stamp video to full-screen broadcast quality. And the platform will continue to evolve from the connected PC of the mid-1990s to the visual computing platform of the late 1990s, to the interactive life-like experience platform of the next century. The focus will be on improving the PC experience at the same relentless pace the PC industry has pushed all other boundaries of new technology", Grove said.

Although Moore's Law points towards 10GHz chip in 2011, Grove said, Intel and the semiconductor industry will have to overcome many tough obstacles to build such chips. The circuitry will have to be produced with chip features down to 0.07 micron, compared to 0.35 micron in today's Pentium Pro chips. Already, Intel is spending some US$2.5 billion on each new plant, and that will increase to as much as $10 billion over the next 10-15 years.

Even at that cost, Grove said, those fabs can be highly profitable, provided that the number of people and companies in the market for systems powered by these chips is large enough. "The economics of our industry only work if we have large numbers of users

demanding our technology. We have an economic mandate to grow the user base for our products", Grove said.

In reflecting back on the 25 years since Intel invented the microprocessor, Grove noted that the company has actually underestimated the pace of technological change. In 1989, for example, Intel estimated that the microprocessor of 1996 would contain eight million transistors, operate at a speed of 150MHz and perform 100 million instructions per second. In fact, Intel's Pentium Pro chips contain just 5.5 million transistors but run at 200MHz and perform 400 million instructions per second. "We have learned to do a lot more with fewer transistors."

Gates defends the PC

Before exposing his COMDEX audience of nearly 10,000 souls to his view of the future, Microsoft's Bill Gates spent about 20 minutes putting up defenses around the Wintel PC platform on which his company's future is so heavily dependent.

Without naming any of his competitors by name, Gates built his case around the premise that the PC is flexible enough to adapt to, and subsequently render useless any technological challenger that crosses its path.

"During the past decade there have been several times when people have looked at the PC and said: 'Hey, there's something missing here, and maybe we should throw out the applications, the installed base of hardware, the industry structure that we've put together, and start over with something new."

Gates listed several previous challenges to the existing PC platforms of the past, including UNIX workstations, graphical user interfaces, multitasking, X terminals, graphics, and object-oriented programming. Today's PC has either adapted itself to those emerging new technologies or evolved so fast they became useless, such as in the case of object-oriented programming.

"I can't tell you how many COMDEXes I've come to where people debated who was more object-oriented. A great example was Taligent, by IBM, Apple, and H-P. That effort was abandoned after they realized that the PC would be able to adopt object oriented approaches."

When the Internet came on strong in the 1990s, the same questions about throwing out the existing structure in favour of something new has come up once again, Gates said. Even though people will soon be computing in a variety of radical new ways, including over the telephone and on their television, the PC will once again adapt itself.

"All of this is very complimentary to the PC. The PC is still the full-screen device you want to have sitting next to you, to edit your e-mail, do your taxes, and do your homework. It is the full-scale approach."

For that reason, he argued, the PC will continue to become *more* powerful, not less powerful as is being proposed by proponents of the network computer (NC).

"Beyond the disk drive, it will be very hard to eliminate a lot from a system, because if you're going to run a state-of-the-art browser, the memory size or the processor capability, the screen, the graphics, the sound, the pointing device, basically all the things that are in a PC, are absolutely necessary."

Intel CEO Andy Grove: "We're in competition with TV. He who captures the most eyeballs, wins!"

Gates also came close to openly accusing his NC competitors of being less than truthful when they talk about the cost-of-ownership advantages of the NC. "When people talk about total cost of ownership, it is important to have that server aspect, and the extra cost you're creating there, brought into the picture."

Among future technology advances Gates discussed were:

- Symmetrical processing: The number of PCs with multiple microprocessors will increase in the coming years. Already some systems offer up to eight processors. Work is under way, Gates said, to create PCs with up to 16 processors that would provide close to 16 times the performance of a single MPU systems. "We're also doing more to cluster systems together, such as with 'No Shared Clustering', where you simply use the network to coordinate what's going on."

Symmetrical processing and clustering will increase the scalability of PCs. In a benchmark test in 1994, PC systems performed 600 benchmark transactions per minute. Today that has increased to 6000, and within two years, Gates expects to see systems that will perform 60,000 such transactions per minute. "That is a huge improvement and means the PC will be able to handle more than even the most demanding corporate transaction systems that are being used today."

- Terabyte storage: During 1997, Gates predicted, an explosion of companies with databases exceeding one terabyte (10^{12} bytes) will take place. In 1996 there were only 15 such databases. But with the rapid growth of the Internet-based databases that process up to a billion transactions per day, the number will increase rapidly.
- Visual recognition: Already PCs are starting to recognise the voice of their owners. Soon they will start to recognise what they look like and what their gestures may mean. Small digital eyes will enable the computer to make a visual identification of the person sitting in front of a computer before letting him or her use the machine.

"The computer is going to know when I am sitting down and how I am reacting to things", Gates said — adding jokingly "In fact, we could define a new kind of return receipt mail that not only says that a piece of mail was read, but also describes the reaction of the recipient."

- The changing look of the desktop: Gates spent some time outlining forthcoming changes on the PC desktop. One is called 'Active Desktop', which will put the files the users uses most frequently on top while preventing less frequently visited folders and files from taking up space on the desktop. They way users find messages, files, and Web pages will also be merged into a new common format applied universally across all applications.

That capability is reportedly under development in the Memphis project, which feature a browser-oriented user interface in a combined Windows 95, NT and Internet Explorer operating system due out in 1998.

- Making things simpler: New applications and system software updates will come with an Auto Install feature that will avoid users having to concern themselves with questions about whether they have the proper drivers.

Continued on page 71

FORUM

Conducted by Jim Rowe

The US Report that does/doesn't put paid to the EMR-Health debate...

As an aside to our own debate on the possible health risks of electromagnetic fields from things like cellular phones, I thought we'd look this month at the recently released *Report on Possible Health Effects of Exposure to Residential Electric and Magnetic Fields* by the US National Academy of Sciences/National Research Council, and the decidedly mixed reactions to it over there. This is more relevant here than you might think, because it seems likely that *our* health authorities and industry lobbyists will use the US report as supposed 'proof' that those worried about the health risks from power lines, electric blankets and so on were mistaken.

The funny thing is that as far as I can discover, the report doesn't even attempt to 'prove' anything of the kind — although various industry groups in the US seem to be keen to interpret its findings in that way. It *does* seem to be a report capable of being interpreted in various ways (some of them almost diametrically opposed), though, depending on the particular axes that some people are intent on grinding. And there's always the risk that 'absence of evidence' is capable of being turned around to imply 'evidence of absence', of course...

But I'm jumping ahead too far. First, a bit of background. In 1991, as a result of growing public concerns about the possible health risks from electric and magnetic fields associated with high-voltage power lines and household electrical appliances, the US Congress asked the National Academy of Sciences (NAS) to review the research literature and determine whether there was sufficient scientific basis to assess the health risks from exposure to these fields. Legislation also directed the US Department of Energy to enter into an agreement the NAS, and as a result the National Research Council (NRC) convened the Committee on the Possible Effects of Electromagnetic Fields on Biologic Systems.

The committee was asked 'to review and evaluate the existing scientific information on the possible effects of exposure to electric and magnetic fields on the incidence of cancer, on reproduction and developmental abnormalities, and on neurobiologic response as reflected in learning and behaviour'. It was also asked to focus on exposure modalities found in residential settings; to identify future research needs and to carry out a 'risk assessment' in so far as the research data justified this procedure.

The members of the Committee included a fair number of 'big names' from US research and public health bodies, as you can see from the box below.

Anyway, the Committee finally released its Report on October 31, 1996, accompanied by an NAS/NRC press release to the effect that it had basically found 'no adverse health effects shown as a result of residential exposure to electromagnetic fields'. The press release did point out, however, that the Committee had concluded that more research was needed, to answer some of the questions 'that linger after nearly two decades of intensive research', regarding things like the incidence of childhood leukemia in houses near power lines, and the relationship between high exposures to EMFs and breast cancer.

Here's a brief summary of the Report's conclusions:

Based on a comprehensive evaluation of published studies relating to the effects of power frequency electric and magnetic fields on cells, tissues, and organisms (including humans), the conclusion of the committee is that the current body of evidence does not show that exposure to these fields presents a human-health hazard. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produce cancer, adverse neurobehavioral effects, or reproductive and developmental effects.

The committee reviewed residential exposure levels to electric and magnetic fields, evaluated the available epidemiologic studies, and examined laboratory investigations that used cells, isolated tissues, and animals. At exposure levels

NRC/NAS REPORT ON POSSIBLE HEALTH EFFECTS OF EXPOSURE TO RESIDENTIAL ELECTRIC AND MAGNETIC FIELDS: The Committee Members...

CHARLES F. STEVENS (Chair), Howard Hughes Medical Institute, Salk Institute, La Jolla, Calif.
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BRUCE J. KELMAN, Golder Associates, Inc., Redmond, Wash.
RICHARD A. LUBEN, Division of Biomedical Sciences, University of California, Riverside, Calif.
RUSSEL J. REITER, Department of Cellular and Structural Biology, University of Texas Health Sciences Center, San Antonio, Tex.
PAUL SLOVIC, Decision Research, Eugene, Oreg.
JAN A.J. STOLWIJK, Department of Epidemiology and Public Health, Yale University School of Medicine, New Haven, Conn.
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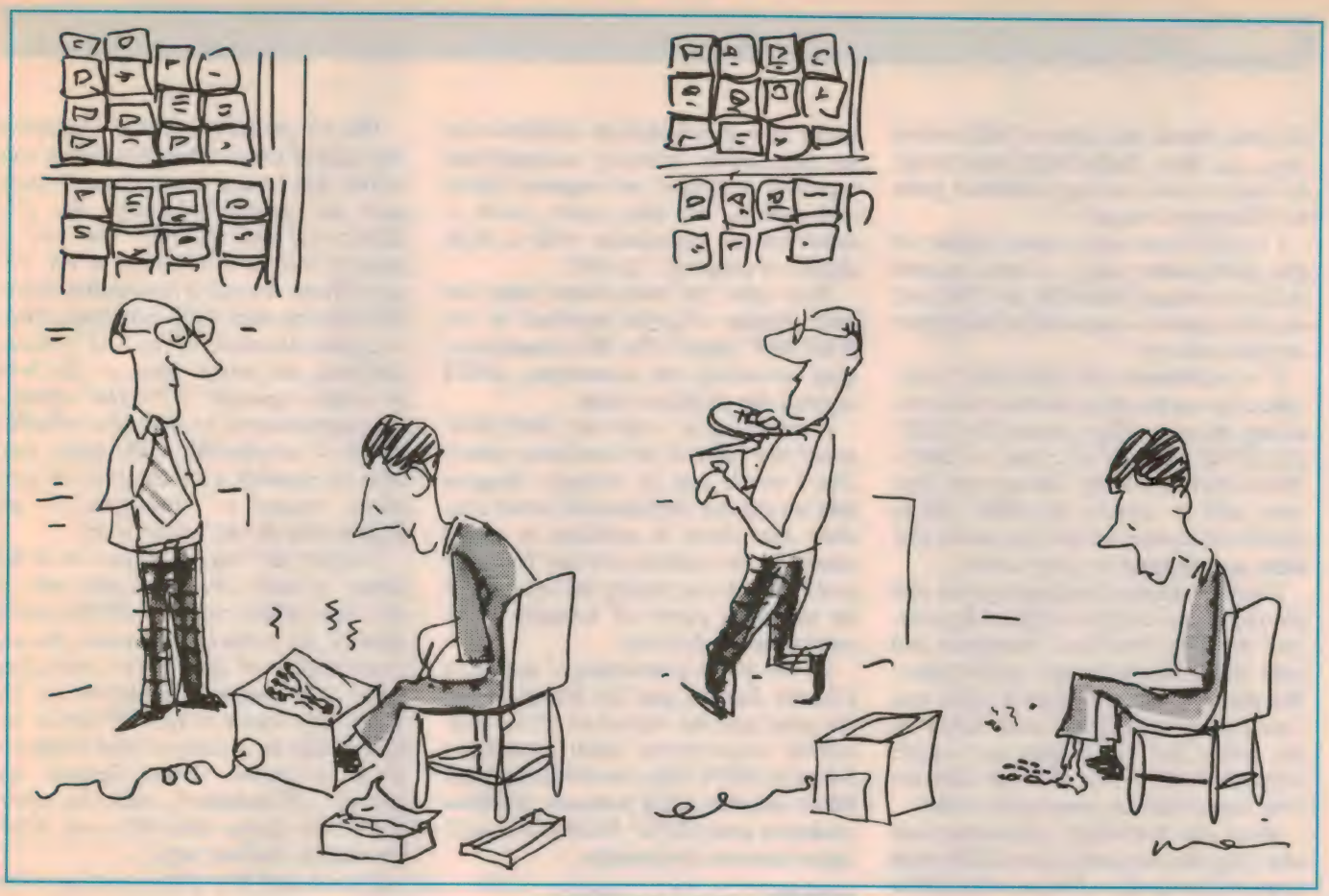


well above those normally encountered in residences, electric and magnetic fields can produce biologic effects (promotion of bone healing is an example), but these effects do not provide a consistent picture of a relationship between the biologic effects of these fields and health hazards. An association between residential wiring configurations (called wire codes, defined below) and childhood leukemia persists in multiple studies, although the causative factor responsible for that statistical association has not been identified. No evidence links contemporary measurements of magnetic-field levels to childhood leukemia.

Not surprisingly the popular media immediately jumped on the Report's findings, as supposedly showing that there *were* no health risks associated with power lines or domestic appliances. For example the *San Francisco Examiner* ran a front-page story the same day as the report was released, headed 'POWER LINES CLEARED AS CAUSE OF CANCER'.

But reaction to the Report from within the scientific community was much more critical. Some leading researchers soon let it be known that in their opinion the Committee had been politically manipulated and made to serve powerful industrial interests, 'rubber stamping' a previously determined agenda.

Three of the Committee members (Drs Luben, Stuchly and Anderson) were motivated to release a separate press release, stressing their concern over some aspects of the Report's conclusions and the way they might be interpreted. In their release they stated that "The most important aspect of this report is that it establishes that even under the strictest possible standards of proof, there is a reliable, though low, statistical association between power lines and at least one form of cancer. This fact in itself shows that we need to do more to find out why this relationship exists."

A later part of their release stated that:

Drs. Luben, Anderson and Stuchly agree with the report's key conclusions that the data are not convincing that there is a proven danger to the public from electromagnetic fields — but also that EMF exposure does result in a number of biological effects. They caution against taking the attitude that a lack of confirmed proof at this point in the study of EMF effects means that the question can be ignored. They point out that even in the case of cigarette smoking, it took nearly 50 years after the demonstration of a statistical association with lung cancer for scientists to define a specific cellular mechanism by which compounds in smoke could definitely cause the cellular changes associated with lung cancer. They emphasize that, in the view of scientists, research is the only way to find the answers to unexplained observations such as the apparent link between EMF exposure and some forms of cancer.

By the way in addition to his research work in Biomedical Sciences at the University of California in Riverside, Professor Richard Luben is also President of the Bioelectromagnetic Society (BEMS), an independent organisation of scientists, medical researchers and bio-engineers. Drs Maria Stutchly and Larry Anderson have also been past presidents of the same society.

Mixed reactions

If the US power industry, appliance makers and cellular radio industry had been hoping that the NAS/NRC Report would put an end to the ongoing debate about possible health risks from EM fields, they've probably been rather disappointed. Because if anything, the Report seems to have done almost the reverse by stirring things up again.

Only a few days after it was released,

Dr Louis Slesin the editor of *Microwave News* (a New York-based newsletter devoted to non-ionising radiation) gave the following critique:

I would advise any serious student of the EMF-cancer story to look beyond the press release issued by the NAS and read the report — especially the chapter on epidemiology.

It is unfortunate the NAS-NRC committee set such a strict standard for evaluating the data: They looked for CONCLUSIVE evidence of a link to EMFs. When this requirement was not met, they were able to dismiss the EMF link to childhood cancer and tell the world that there was nothing to worry about.

This is a strange conclusion given that the panel said that the original association between childhood leukemia and wire codes, first reported by Dr Nancy Wertheimer and Ed Leeper in 1979, was 'statistically significant' and 'robust in the sense that eliminating any single study from the group does not alter the conclusion that the association exists'.

What the NAS-NRC committee was unwilling to conclude is that EMFs were responsible for the wire code link. What then are wire codes surrogates for? At this point, the committee threw up its hands and said they do not know.

According to the report: 'At present, confounding remains a possible explanation for the wire code and cancer association. However, past efforts to identify such confounders have failed and few strong candidates can be postulated at present.' (p.153)

That is, the committee has no idea what else — if not EMFs — could be responsible. Is it therefore fair for the committee to sound the all clear?

The committee also said the occupational EMF-cancer studies could be useful in explaining the EMF-wire code 'paradox': 'The sources of bias are largely distinct for the studies of residential exposure and childhood cancer versus occupational exposure and adult cancer, so that if both research avenues have been misleading, they have been so in different ways. If occupational studies are pursued to clarify the issue and if they provide more conclusive evidence that magnetic fields can cause brain cancer and leukemia in adults, they will add more substantial indirect support to the proposition that magnetic fields can cause cancer in children.' (p.161)

And, more specifically: 'Overall, the most recent studies have increased rather than diminished the likelihood of an association between occupational exposure to electric and magnetic fields and cancer, but they have failed to establish an association with a high degree of certainty.' (p.169)

Here again the data cannot meet the strict burden of proof required by the NAS-NRC panel. But the occupational data, according the committee, DOES support the childhood data.

I would agree with the NAS-NRC panel that there is no conclusive proof. But I would just as strongly disagree that we can tell families with small children that there is nothing to worry about, as the academy did last Thursday and succeeded in putting this conclusion on the front pages of virtually every newspaper in America.

At the press conference, I asked Dr Charles Stevens and Dr David Savitz, the chair and the vice-chair of the committee, respectively, what probability (short of 100%) they would venture that [there may be] *a link between childhood leukemia and EMFs? Neither was willing to answer the question.*

BEMS urges caution

A couple of weeks after the Report had been released, Dr Richard Luben of BEMS was himself urging that it should be interpreted with great care:

The unfortunate thing about this report was that the manner of its release by NAS did not do the report justice. The message taken away by reporters from the NAS press conference was clearly that there is probably no danger from EMFs. I honestly don't think that is an adequate characterization of the conclusions of our committee.

I and others issued a supplementary press release as an attempt to focus attention, not on areas where the NRC report reached NO clear conclusions (e.g. insufficient proof that magnetic fields cause health hazards), but on the areas where we spent most of our time and work — and where we DID reach scientifically reliable conclusions. The most important of these areas, in my opinion, was the meta-analysis of the epidemiological data, which was more extensive, more thorough, and I daresay more skeptical than any previous meta-analysis. We found after this extensive analysis that there IS a reliable statistical association between childhood leukemia and power line proximity ('high wire codes').

You are probably right in suggesting that a lot of people thought this was true before, but I think we can now be quite sure the correlation exists. We also determined that the EMF data are at present too poor to account for this association beyond a reasonable doubt. This finding does NOT exculpate EMFs as a possible cause of the link between leukemia and power lines, as has been so widely reported. We called strongly for more research to determine whether EMFs — or possibly some other variable, or possibly a combination of variables, related to powerlines — are responsible for this correlation.

I might add that to the person in the street, it really doesn't matter what is the cause of the cancer — EMFs, traffic density, air pollution, or some obscure combination of the factors associated with 'wire codes'. The person in the street only wants to know if she or her family may be in danger from living too close to power lines. Despite the panoply of headlines, what the report really says is that there IS a risk. Ergo, we need to find out why...

It's too bad that discussions pointing out the positive and reliable findings of the report now have to be carried out on internet newsgroups and in letters-to-the-editor columns, while the inconclusive sections of the report are what gets splashed on page 1.

So on the whole, the NAS/NRC Report hasn't exactly ended the debate on possible health risks from the EM fields associated with power lines or home appliances. If anything, it seems to have provided fuel for renewed debate, especially in the USA. It might be worth bearing this in mind, in case some Australian health authorities and industry spin doctors try to suggest otherwise in the coming months.

And cellular towers?

Of course the NAS/NRC Report was at least nominally focussed on the fields from high voltage power lines and home appliances like electric blankets and microwave ovens, all operating at 60Hz. So whatever the conclusions that might be able to be drawn from it, they probably don't apply directly to the fields from UHF cellular phones and their transmission towers.

In this context, though, I was very interested to see a transcript of an address given at a conference called 'Unplugged: Health & Policy Implications of the

Wireless Revolution', held at the Vermont Law School in mid-November 1996. The address was given by Ms Cathy Bergman-Venezia, who is President of The EMR Alliance, a New York-based international non profit organisation formed in 1990 to provide a forum for citizen and consumer action groups involved in electromagnetic radiation issues.

A copy of Ms Bergman's address, titled 'Cell Tower Static: Consumers Cause Interference In The Race To A Wireless World' was very kindly sent to me by Don Maisch of EMFacts in Hobart, who has contributed to our own debate previously. Thanks, Don!

The transcript is fairly long; a bit too long to try reprinting here. However it makes such interesting and challenging reading that I can't resist giving you a few excerpts — I trust Ms Bergman and the EMR Alliance won't object, because a lot of what she said seems to me just as relevant here as it is in the USA. See what you think, anyway:

Health and safety concerns associated with exposure to cellular transmitting facilities that have been raised by consumers have, by and large, gone unheeded by the communications industry, much as the original powerline concerns were ignored by the utility industry until consumer activists began to systematically block the construction of power line corridors, force rerouting, undergrounding and mitigation efforts.

Much evidence...

Contrary to what the communications industry tells us, there is vast scientific, epidemiological and medical evidence that confirms that exposure to the radio frequency (RF) and microwave radiation emitted from cellular transmitting facilities can have profound adverse effects on biological systems.

A September 19th press release from the communication industries' mouthpiece CTIA, confirms that the wireless communications industry has set new annual records with over $20 billion in combined revenue in the last twelve months in the US alone. With $20 billion dollars a year at stake, you can damn well bet that their studies are going to show whatever they want them to show.

In fact, Dr David Savitz, a long-time champion of the link between exposure to electromagnetic radiation and the development of illness and disease, has become mute on the subject after receiving a $5 million grant from communications giant Motorola.

I am sure that the tobacco industry analogy is clear to everyone. For decades our government told us that cigarette smoking was not harmful, while anyone with an ounce of commonsense knew that there was a serious risk factor involved in smoking. When health concerns escalated, the US government backed down in its support of the industry. But the tobacco industry surged forward, arrogantly continuing to claim that tobacco use was not only not harmful — but quite possibly good for you.

After 50 years of intensive and controversial research, it was just two weeks ago that the link between the use of tobacco and lung cancer was confirmed. The smoking gun, so to speak, had finally been found. Meanwhile, in the 50 year examination of the link between smoking and cancer, smoker after smoker dropped dead of lung cancer.

Interesting analogy

When new technology is introduced, it is easy to become enamoured of it and ignore possible health and safety ramifications. An interesting analogy springs to mind. In the early 1950s, a wonderful new product was introduced to the world: a pedascope machine to check how well your shoes fit before you made your purchase. Consumers would insert their feet into a hole in the product and look down at a display screen. Children marveled that they could wiggle their toes and see them move inside their shoes.

The machine used X-rays at quite a high level to give real-time images on a simple screen. It was not until 10 years after this product was introduced to the marketplace that Dr Alice Stewart produced research which showed that there was no safe level of X-rays. Very few listened to her concerns. Many scoffed.

"Impossible", they said. "You have no proof that this is dangerous" they said. "We have studies that show it is safe", they retorted. In fact, Dr Stewart became almost an outcast of the medical establishment for her strong position on this issue. It was close to 20 years later that the real danger from medical X-rays was acknowledged.

When the Atomic Bomb tests were conducted in the Nevada desert, the US government advised the American public, and the illustrious American Physical Society (APS) concurred, that there was no danger from the radioactive fallout from the Atom bomb tests. "Completely harmless" the government said. "Nothing to be concerned about" the APS concurred.

The communications industry scoffs at those of us that intimate real danger from their technology. "Impossible" they say. "You have no proof that it is

dangerous", they retort. "Completely harmless" they cry. "We have studies that show it is safe" they respond.

X-rays, atomic radiation, thalidomide, benzene, asbestos. How many times has industry and the US government sanctioned products and technology — only to find that not only are they harmful, but very harmful?

As we have heard over the past two days, The Telecommunications Act of 1996 established the Federal Communications Commission (FCC) as the regulatory agency to guide radio-frequency safety levels. This, in spite of the fact that the FCC has acknowledged that it is not a public health agency.

In essence, the current FCC safety guidelines do insure that if you spend a great deal of time in close proximity to a cellular transmitter that you won't cook — that's what the guidelines are effective against, thermal heating. Health effects from radio-frequency and microwave radiation exposure are related to all characteristics of exposure, including frequency, duration and type of modulation, not just intensity.

The FCC safety guidelines make sure that we won't cook — that's about all they protect against. These standards, to which several petitions for reconsideration have been filed by consumer activists and are pending, do not address chronic exposure to radio-frequency and microwave radiation from these facilities and the resulting development of illness and disease.

In spite of the current FCC RF safety guidelines, it is apparent from the intense opposition to cellular tower siting that consumers refuse to act as human guinea pigs in a bio-effects experiment for the next 50 years, until the smoking gun is found that will conclusively link exposure to electromagnetic radiation and the development of illness and disease.

After giving a list of examples drawn from all over the USA, where groups of concerned residents and consumers have been able to influence the siting of cellular phone towers, Ms Bergman continues:

Consumer opposition to cellular tower siting is not confined to the United States, and a strong global opposition is occurring that has resulted in similar bans and moratoriums around the world. New Zealand, for instance, has banned all cellular towers on school property in an effort to protect its children from RF and microwave radiation...

To help consumers mobilize against the placement of cellular facilities where they believe that such placement would adversely affect their health, safety, property values or the esthetics of their community, The EMR Alliance, in conjunction with the Communications Workers of America (CWA) are pleased to announce their joint publication of 'Your Community Guide To Cellular Phone Towers' which will be available on December 1st. This publication is unique because it brings together consumer concern as well as the concern of the workers who are building the cellular towers throughout the United States.

In addition to this guide, The EMR Alliance has compiled a comprehensive package of over 300 pages that include news clips and television transcripts detailing consumer opposition to cellular installations, moratoriums, sample petitions, letters to and from various government and regulatory agencies, press statements and other information that we make available to consumers, to assist them in building a comprehensive argument against unsafe cellular facility siting in their community.

The communications industry may have $20 billion dollars in annual revenues on their side — but I believe that we have the truth on our side.

Margaret Mead said it best: "Never doubt that a small group of concerned citizens can change the world; indeed, it is the only thing that ever has."

And that probably isn't a bad note to end both this month's column and our look at the ongoing EMF/health debate, at least for the present. I have no doubt that we'll return to it before long, but next month we'll give it a rest and look at other topics for a change.

Before I close, though, I should perhaps pass on a few relevant electronic addresses for those who have Internet and/or WWW access and are interested in getting further information on the subject of EMFs and health.

You'll a lot of material on the Bioelectromagnetics Society (BEMS) at http//biomed.ucr.edu/return.htm. For more information on *Microwave News*, you can find its home page at http//www.microwavenews.com. The EMR Alliance doesn't seem to have a WWW presence, but they do have an e-mail address: Emrall@aol.com. And finally, Don Maisch at EMFacts Information Service in Hobart, who is a mine of information on the local scene, can be contacted by e-mail at maish@netspace.net.au. ❖

ELECTRONICS AUSTRALIA'S READER INFORMATION SERVICE COMPUTER BULLETIN BOARD

As part of its service to readers, *Electronics Australia* operates a Reader Information Service Bulletin Board System (BBS). This makes available a wide range of useful information, for convenient access and rapid downloading by readers equipped with a personal computer and modem. We know that a high proportion of our readers have these facilities, nowadays.

Here's an idea of what's currently available on the BBS:

- Software needed for recent PC-based EA construction projects
- Index files for EA and ETI construction projects
- Recent notes and errata, both published and as-yet unpublished
- Useful public domain and 'shareware' software for electronics and amateur radio applications.
- General interest shareware utilities, such as the commonly-used compression and decompression utilities used for efficient storage and faster file transfer.
- The ability to upload Letters to the Editor, and/or contributions to our Forum and Information Centre columns (send them as plain-text ASCII files, please)
- An on-line 'Discussion Forum' facility, which allows readers to exchange useful technical information directly.

The *Electronics Australia* Reader Information Service BBS is ANSI-compatible and is currently operational for virtually 24 hours each day, seven days a week, on (02) 9353 0627. Your modem can be set to any standard speed from 300 to 28,800b/s full duplex, with a data format of '8-N-1' (eight data bits, no parity and one stop bit).

So feel free to call up the *Electronics Australia* BBS, and take advantage of its facilities. Your only outlay will be the usual cost for a phone call...

Experimenting with Electronics

by DARREN YATES, B.Sc.

Flip Flops - 1: The D-type Flip Flop

This month, we start looking further afield at some of the specific function blocks in CMOS, starting with the 4013 D-type flip flop. We look at its pinouts and some example circuits, for both learning and practical use.

One of the benefits of working with CMOS ICs is that there's almost an IC to cover just about every digital building block you require, but you can also mix and match them to suit your own requirements. During the last couple of months as we've looked at CMOS gates, you hopefully would have seen that while the CMOS gate can handle quite a range of functions, to make all of those circuits up with gates alone would be pretty fiddly.

While they are all practical, you can't help think that there has to be a better way, or at least an easier way, to make them.

The clever people who came up with the idea of logic ICs also thought the same thing. They saw that there were little circuit fragments that they were using repeatedly. And the flip flop was a perfect example. Now while there are a number of RS-type flip flop ICs in the CMOS range, that contain upwards of four flip flops inside, the next chip we'll look at is the 4013.

This IC contains two flip flops that are slightly different from your bog-standard RS-type. Known as the D-type flip flop, the 4013 contains two, which have standard RS functionality built into them as well. A basic circuit diagram on the 4013 is shown in Fig.1. This is the first multi-input/output IC we've looked at as far as CMOS ICs are concerned, so we've labelled all of the inputs and outputs.

Basically, the D Flip Flop contains four control inputs and two outputs. The first two inputs are the SET and RESET inputs. These override any other input in this flip flop. When the SET input is pulled high, the Q output goes high and when the RESET pin is taken high, the Q output falls low. The Q-bar output is simply an inverted copy of the Q output — i.e., when Q is high, Q-bar is low and vice-versa.

The next two inputs are new and are called CLOCK and DATA. When a positive-going edge arrives at the CLOCK input, whatever is on the DATA input is sent through to the Q output. So if the DATA input is high, a rising edge on the CLOCK input will shift that DATA high to the Q output as a 'high'.

And that's about it. There are some minor rules which you'll need to worry about if you're designing some you-beaut circuitry, but on the whole, that's all you need to know to get started.

So what can you do with a D-flip flop? D-flip flops open up a whole new area of digital electronics that really isn't practical with simple RS flip flops.

Frequency divider

The circuit in Fig.2 is a very simple but very practical use for a D flip flop. It takes an input signal at the CLOCK input of pin 3 and spits out a squarewave of exactly half its frequency at the Q and Q-bar outputs. It works by virtue of the fact that it takes one complete clock cycle for the data input to reach the output. By feeding the Q-bar output back to the data input, we're always alternating the logic level at the data input. And as it takes two clock cycles to complete a single high-low output cycle, we've effectively halved the input frequency.

Note that the SET and RESET inputs are grounded. Because CMOS inputs are very high in impedance, they can pick up signals from anywhere! To ensure that the circuit operates the way you want it to, make sure that all your unused SET and RESET inputs are grounded.

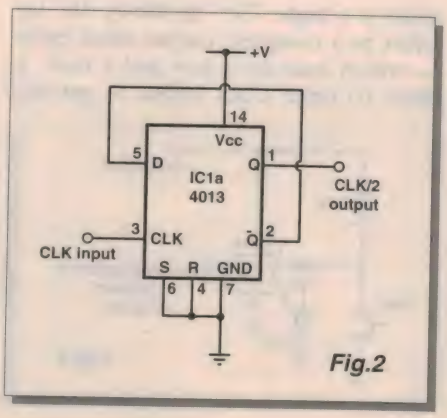


Fig.2

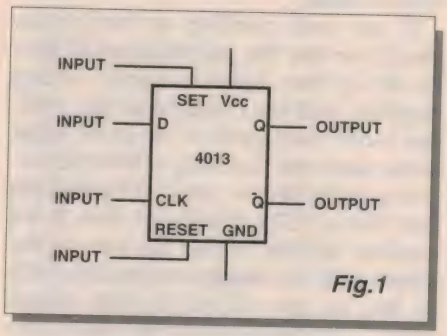


Fig.1

Just to make things tricky, most circuits don't bother to include unused inputs on the actual circuit diagram, simply because it's more work for the draftsperson. If a circuit doesn't include an input that may exist on a chip, assume that it's not being used and tie it to ground. As most CMOS inputs are positive-triggered, i.e., they work on positive going edges or on +V input levels, this should be OK — but just check your particular chip to make sure.

Now there are some good uses for this simple circuit. Firstly, it's a very simple divide-by-2 circuit, which may not sound important at the moment but we'll show you shortly how it can be used to make a very effective counter. Secondly, it's a useful tool for turning a pulse waveform into a perfect squarewave of half its frequency — and for some circuits, this is very important. Thirdly, the two out-of-phase outputs are also a handy feature which we'll also make use of in the future.

As you go about designing your own circuits, you'll be surprised how often this circuit will come in handy.

Binary counter

While the circuit in Fig.2 is great as a frequency divider, it also gives us the very basics for creating a digital counter. The circuit in Fig.3 is simple four-bit binary counter. The name may seem complicated, but it's just a case of learning the lingo. 'Four-bit' means that it has four binary outputs, each of which can be either high or low; 'binary' means that it counts only ones and zeros; and 'counter' because that's what it does.

If you look carefully at the circuit, you'll see that it's just made up of four divide-by-two circuit blocks strung together, with the Q-output of the previous block connected to the clock input of the next one. Looking at how the circuit actually counts, you can see that the first block, IC2a, divides by two. If we connect another divide by two to the output of IC2a, simple mathematics tells us that we get a divide-by-four output from IC2b. Plonk another divide-by-two on the output of that and you get a divide-by-eight. The fourth D-flip flop gives us a divide-by-16 output.

OK. That's the dividing, so let's see how it actually counts.

Looking at the circuit again, you can see that each Q-output is given a number. This lets us easily distinguish not only which output we're talking about, but also let's us know what *weighting* each bit has.

If we feed a clock signal, which is simply a more relevant way of saying an pulse waveform, into the first clock input at pin 3 of IC1a, the Q-output at pin 1 goes high because the Q-bar output connected to the D input was high.

On the second clock pulse, Q1 falls low because its Q-bar output switched low; but Q2's output now goes high, because Q1's output was high.

On the third incoming pulse, Q1 goes high again (remember that Q1 will alternate all the time) but Q2 stays high, because the previous Q-bar has gone from high to low (remember that these clock inputs trigger the flip flop on the rising edge, not on the absolute voltage level).

On the fourth pulse, Q3 now goes high because Q2 was high.

We could go on right through, but suffice to say that each successive Q-output alternately goes high at half the speed of the previous. We can write out the sequence as shown in Table 1.

As you can see, there are 16 different states from zero to 15. If Q1 has a weighting of one, Q2 two, Q3 four and Q4 eight, you can see how the circuit actually counts using simple binary maths.

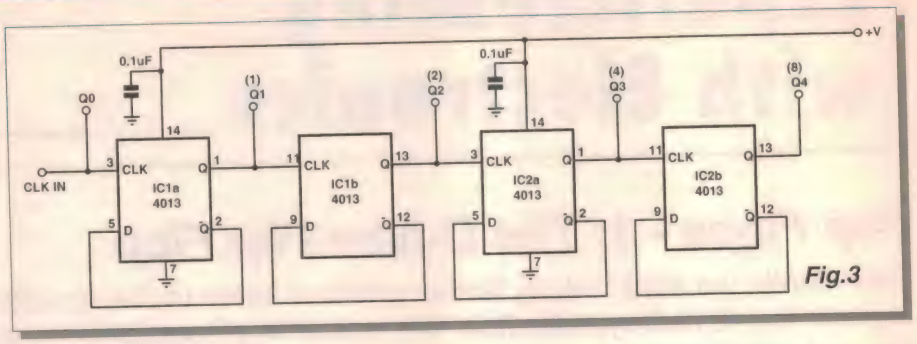


Fig.3

Now it might seem a little confusing that Q4 has a binary 'weight' of eight when it's a divide-by-16 output. Remember that the Q4 output effectively only matters to us, in this situation, when it's high. The 'divide-by-16' tag refers to a complete output clock cycle — which includes a low and a high. It takes 16 input clock cycles to get one cycle from this output. This also works for the other outputs as well.

TABLE 1: Binary Counter states

Q4	Q3	Q2	Q1	
0	0	0	0	(0)
0	0	0	1	(1)
0	0	1	0	(2)
0	0	1	1	(3)
0	1	0	0	(4)
0	1	0	1	(5)
0	1	1	0	(6)
0	1	1	1	(7)
1	0	0	0	(8)
1	0	0	1	(9)
1	0	1	0	(10)
1	0	1	1	(11)
1	1	0	0	(12)
1	1	0	1	(13)
1	1	1	0	(14)
1	1	1	1	(15)
0	0	0	0	(0)
0	0	0	1	(1)
	etc...			

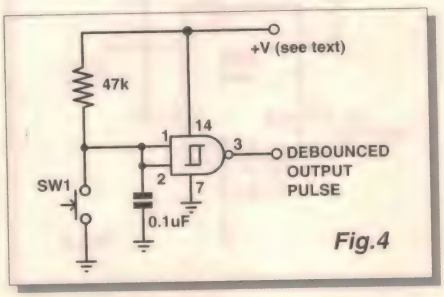


Fig.4

Work through this at your own pace — it's important to work things out as you go, otherwise you'll compound the problem later.

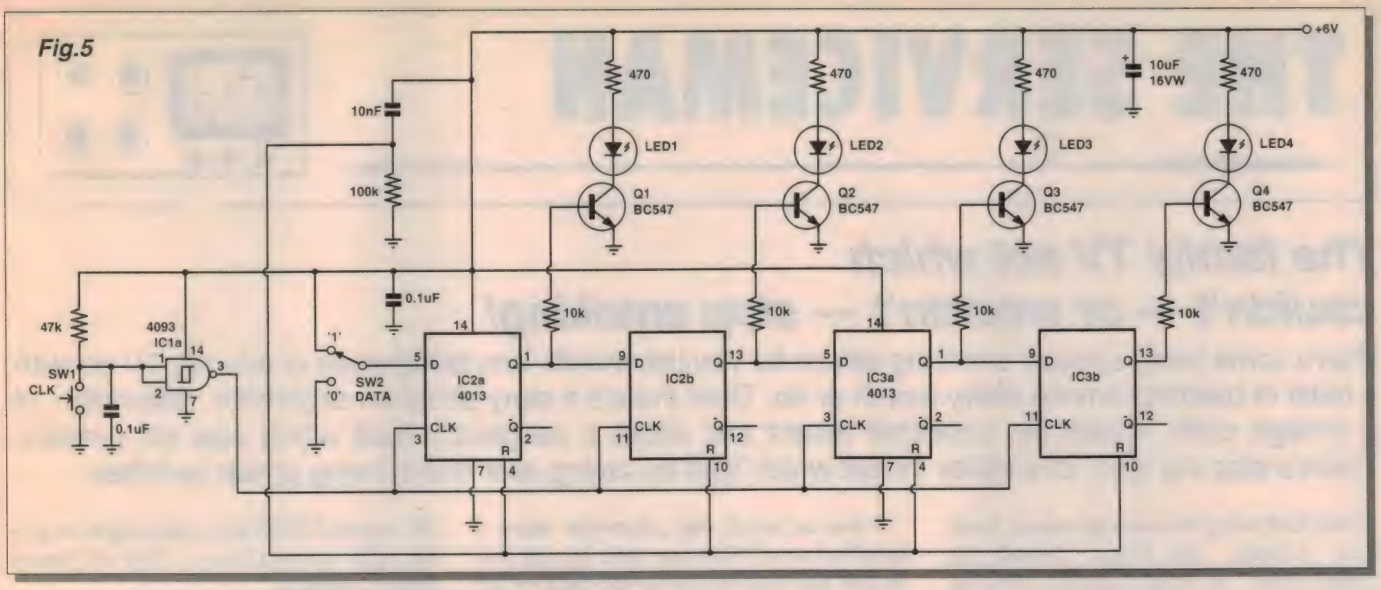
Once the circuit reaches the 1-1-1-1 output, it simply curls around back to all-zeros, and counts up again.

So far we haven't talked about Q0. Even though this is the clock signal, you could use this as a fifth bit — giving you a count up to 32. This pushes all the successive Q's up one notch, so that Q4 has a weighting of 16, Q3 of eight, Q2 four, Q1 of two and Q0 one. It may look pretty complicated, but the counting principle is still the same.

OK. From a design point of view, it's important to remember too that the amplitude of the clock input must not exceed the supply voltage of the flip flops, otherwise you might blow the first gate. The simple insurance for this is to just power the clock source from the same supply rail. If that's not possible, you'll need a level translator which will convert the amplitude to the correct level.

You may have noticed that there is a 0.1uF bypass capacitor connected to the supply rail pin of each IC. While this is not mandatory, it's a pretty good idea in any case to include when you're laying out a circuit on PC board. Digital circuits are renowned for disruptive 'glitches' appearing all over the place. The 0.1uF capacitors simply shunt any of these glitches down to the ground rail and away from critical input paths. Blue-chip monolithic capacitors are fine for this job.

This is not an easy area to understand the first time through, so have a look at it a few times until you're comfortable with the concepts. Unfortunately, lack of space denies us the chance to really expand on these ideas. If you're interested, there are a number of good books available which give more detail on what we've included here.



An interesting aside to the circuit in Fig.3 is that if you take the Q-bar outputs instead of the Q-outputs, you'll actually get the binary counter counting *down* instead of up. This can also be useful in a number of applications such as countdown timers.

Finally, this circuit is also called *asynchronous*, because the clock inputs are not connected together but to the previous Q-output. While everything does happen extremely fast, there is a small delay as each output 'ripples down' to the next flip flop. The worst case of this is when you go from all-ones to all-zeros, with all outputs changing state in sequence. In very high frequency applications, this 'ripple carry' delay time can cause big problems.

Debounce switch

Fig.4 shows a little circuit which will be invaluable as you build up some of these circuits. Because you can't really control just when an oscillator starts and stops precisely, this circuit makes a good alternative by creating single clock pulses when you press the switch. It's suitable to drive most of these circuits we're looking at.

Some people we'll be thinking that if the clock input is positive-edge triggered, why not just hook up a switch and resistor to the clock input? Nice idea, but in practice, switches are noisy objects. When you press a switch, you may thing you're creating a single pulse but if you look at it on a high-speed CRO, you'll see a number of pulses as the switch makes and breaks contact. Basically this is because all mechanical switch contacts 'bounce'.

This circuit gives a guaranteed single pulse per press. The RC capacitor filter removes most of the spikes so that you get only minimal noise as the switch closes. The Schmitt trigger gate then ensures that whatever noise remaining is removed and ignored. I grant you it's wasteful of three gates, but it's quick and easy to build.

Shift register

Another application of the D flip flop is the *shift register.* As its name suggests, a shift register is a row of flip flops in which one bit of information is passed along, very similar to a production line or conveyor belt. The circuit in Fig.5 is a complete example and a good learning aid to show how a shift register works.

Looking at the circuit, it includes the debounce circuit from Fig.4 — this circuit would be too quick for you to see its action if we used a normal oscillator. The output of this debounce switch is fed into the clock input of IC2a. Note in this circuit that all of the flip flop clock inputs are connected together, so you'd call this a 'synchronous' circuit.

Whereas in the counter circuit the Q outputs fed the next clock input, the Q outputs now feed the next D input. Note also that each Q output drives a LED. When the LED lights out, its corresponding Q output is high.

Let's look at the operation.

When the power is switched on, the circuit is reset via the RC time constant connected to all reset inputs. This ensures that all flip flops have low Q outputs, so that all LEDs are off. If switch SW2 is flicked to the '1' position and SW1 pressed, LED1 should light up.

If you now flick SW2 into the '0' position and press SW1 three times, you should see that first bit travel along the register, as each LED from LED1 through to LED4 lights up in turn. You can change the SW2 data input at any time before pressing SW1 and see each bit travel down the register like a conveyor belt. Note that once a bit is entered into the shift register, you can't change its value.

For an alternate effect, you can reconnect the LED drivers to the Q-bar outputs instead. In this case, the LED will go out as each high bit of data travels along the register. This function can be useful in some applications as well.

Shift registers are great for mathematics, particularly for dividing and multiply

Continued on page 79

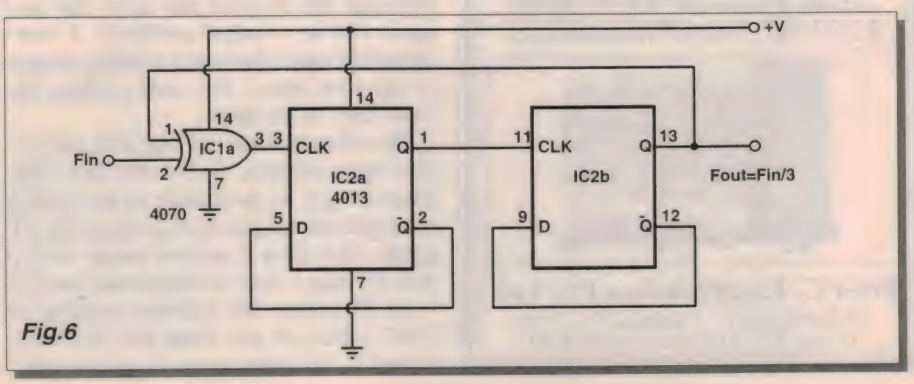
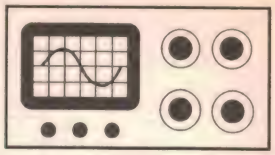


Fig.6

THE SERVICEMAN



The family TV set which couldn't — or wouldn't — stop smoking!

I have some really unusual servicing stories for you this month, one being a tale of a family TV set with a habit of belching smoke every month or so. Then there's a story about an expensive 'restoration' of a vintage radio, where the customer wasn't told about a dangerous fault which was still present. There's also the story of another TV set which kept on arcing over and blowing power switches...

Our first story this month comes from Ray Alford, of Hope Island in Queensland. As Ray explains here, he is not a serviceman but does work with electronics and knows enough about the subject to attend to the ailments that plague his own equipment. Here's what he has to say...

I have been a reader of your column for many years and always find the stories interesting and informative.

My occupation involves another side of electronics, with the monitoring of rivers and streams for flow rate and water quality.

I'm interested in most areas of electronics but as far as TV repairs are concerned, my activities are limited strictly to the family set. The following incident occurred a few years ago and I thought at the time that it might make a good story for your column. Your recent appeal for contributions prodded my conscience, so I put pen to paper and here is the result.

I was at work one afternoon when I received a call from my wife saying that smoke was coming out of the back of the TV. She had switched it off at the wall and was hoping I could fix it when I got home.

The set was an early model Kriesler, fitted with a 59-4 chassis. It had proved reliable over the years and I had only needed to replace the tuner on one occasion due to lightning damage. This time I feared the worst, but an internal examination showed no real damage.

The only likely source of the smoke was R603, an 82-ohm resister on the deflection board which looked like it had been overheated. When power was applied both picture and sound came up normally with no sign of any problem.

This seemed almost too good to be true, and it was. Two months later I received another call at work. The TV was smoking again.

My wife explained that younger daughter Lena had been watching her favourite shows while older daughter Chelle was practising the piano. As these two activities both occur in the living room, Lena had been using a set of headphones when the smoke erupted.

This was the same set of circumstances as before and, although suspicious, I couldn't really blame Lena for the fault.

Inspection of the set revealed that this time R603 was well and truly cooked. I replaced the resistor the next day and again the set worked perfectly. I wondered if it might had been a faulty resistor in the first place. Yes, and perhaps the tooth fairy is for real!

The set continued working fine for several more months, before the next call. Sure enough, in the middle of her sister's piano practice, Lena had blown up the TV again. This time I arrived home with a new 82-ohm 1 watt resistor in my pocket!

As expected, the charred remains of R603 stared at me from the deflection board — but when replaced, guess what? No sound. IC290, the audio output amplifier chip was no more. Then the penny finally dropped.

When Lena had first begun to watch TV using the headphones, I was concerned that she was sitting too close to the screen. I made up an extension cable with a plug and jack that allowed her to sit further away from the set.

On the occasions of the smoke she must have accidentally pulled apart the connection without noticing. Because the earphone plug of the extension lead was still in the set, no sound came from the earphones or the speaker.

Lena's response was to turn the sound up. But with no load and maximum volume, IC290 drew heaps of current, limited only by the 82-ohm resistor on the deflection board. No wonder it failed.

A new IC fixed the sound and a length of insulation tape around the extension cable plug ensured that it would not easily pull apart again.

With the benefit of hindsight I should have been able to solve the problem in less than the 12 months that it really took. My problem was that I couldn't see the connection between the deflection board resistor and the sound stage, either logically or on the circuit diagram. I wonder how a real serviceman would have responded given this fault.

I wonder too, Ray. In fact, the more I think about it the more I appreciate your efforts in solving the puzzle.

My guess is that that before the chip failed, there was no clue to connect the resistor to the audio stage — so even a 'real' serviceman would have very little to go on. I suppose that it all depends on whether or not Lena had reconnected the headphones each time before you got to the set...

Anyway, you finally solved the problem and telling your story here alerts others to what could be a very obscure fault, before the IC fails. Thanks for writing the

story. And does anything interesting happen with your water monitoring equipment? If so, tell us about it.

"I've fixed that..."

Next, we'll take a couple of short items from our New Zealand contributor, Peter Lankshear. There's no need to introduce Peter — he's been writing in this magazine for 10 years or so. However, he is new to the Serviceman pages and a very welcome newcomer he is, too.

Peter calls his first item 'A STICKY PROBLEM'. It follows on from last month's item about the glued-up speaker, and reinforces the idea that set owners should not be allowed anywhere near a gluepot or any other adhesive material! Here's what Peter has to say:

I recently encountered another 'sticky' problem. An enthusiast had discovered a very elderly receiver that I suspect had been stored for some time in a damp location.

It had probably been written off many years ago, but the nostalgia business being what it is, the owner, who has some knowledge of radio equipment, decided to restore the chassis and cabinet to something of their former glory.

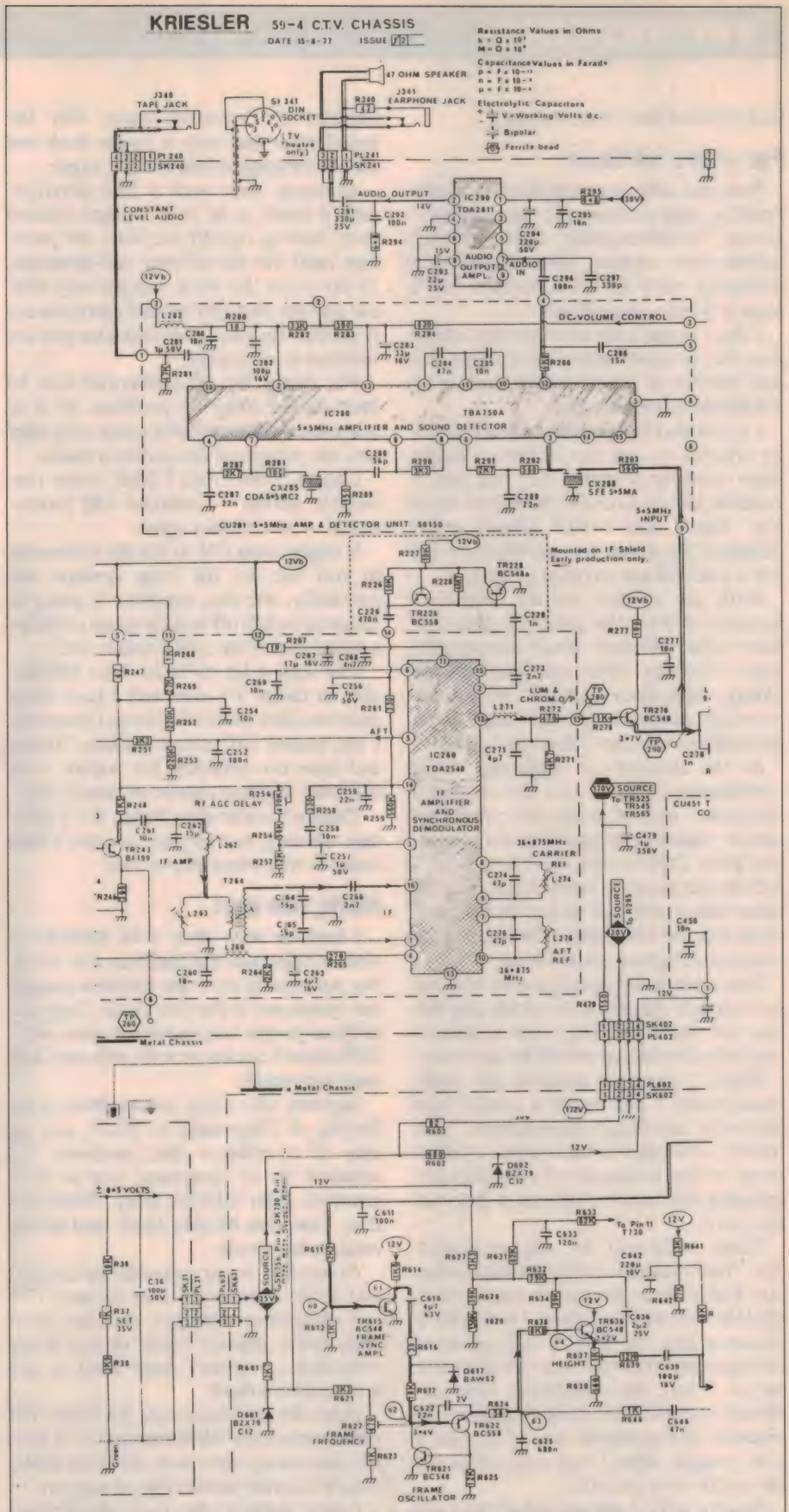
In the process, he got a bit out of his depth — his problems compounded by the fact that several bypass capacitors were missing, and somehow an incorrect oscillator coil had been substituted. Anyway he persuaded me to sort out the problems, and as he was leaving, he casually mentioned that he had applied some varnish to the converter valve socket as it had been arcing.

This was fair enough I suppose, although I do not recall ever encountering the problem in a converter valve socket. The only real cure for this sort of fault is to remove all traces of carbonisation, once arcing has occurred.

I decided that the best approach was to replace the socket, but when I attempted to remove the original, I discovered that the owner had omitted to tell me that he had applied the varnish with the valve in position!

It had been firmly glued in, and there was just no way that valve could be unplugged. Eventually I had to patiently demolish the socket, by systematically snipping little bits off with a pair of sidecutters and prising them off the valve base and pins!

The mind boggles at the stupidity of some people. I mean, it doesn't take much intelligence to realise that varnish is very sticky and that the valve was likely to become fixed in the socket. I suppose the owner didn't even consider this — just ploughed ahead with the



Part of the circuit for a Kreisler 59-9 CTV, which forms the subject of our story from Ray Alford. R603, the resistor that kept on smoking, is at lower centre near zener D602.

first product that came to hand.

Far more serious

Peter has called his next item 'A Shady Practice', and it relates to a far more dangerous misdemeanour than glueing valves into sockets. This effort was extremely risky for all concerned and I hope it WAS a one-off job:

I don't recall ever encountering shady practices by professional servicemen, but one instance of disappointing work from a hobbyist comes to mind.

I was asked by a woman from a country district to get her father's vintage radio working properly. She had paid a sizeable sum to have the American-made big 'black dial' 1937 Zenith radio 'restored' by an amateur serviceman, but felt it was still not working properly.

With the chassis on the bench, it became obvious that precious little had been done. Several small components were showing their age and should already have been replaced. With these renewed, performance was much more acceptable — in fact it was very good.

In the process of replacing these components, I noted that the set was a universal model with an oversized power transformer suitable for operation from 25Hz mains. As is my habit I left the set running while I got on with some other job, but a half hour later, there was the unmistakeable smell of an overheated power transformer.

Sure enough the massive core was too hot to touch. There was no doubt that this was not normal heating, and a replacement or a rewind job would be necessary.

When I came to remove the faulty transformer, I uncovered a strange and decidedly unofficial modification, with freshly soldered connections. Hidden away on the underside of a tagstrip terminating the mains lead was a piece of fuse wire.

There could only be one conclusion. The 'fuse' had been added because someone knew about the faulty transformer. Had the wire not been there, I would have assumed that the failure had occurred subsequently to the previous service work but as it was, my conclusion was confirmed by the owner when I reported the situation. His comment was, "I thought it a bit strange when I was told not to run the set for long periods".

Exactly why a proper repair was not carried out is uncertain, but the transformer was an uncommon type and rewinding is expensive and takes time. Perhaps the repairer hoped that the transformer had only a minor fault and the overheating would not get worse.

However, once such a fault develops, (and it needs to be only a single shorted turn) heating rapidly escalates the problem until the transformer self-destructs. In any event, his work was not very ethical and the fact that he had surreptitously hidden the fuse wire indicates that his motives were suspect.

Far better for all concerned had he been honest about the problem. As it is, and country communities being what they are, his reputation has suffered badly.

I agree, Peter. And I think every reasonable person — amateur OR professional — would also agree.

It might seem OK to tell the owner not to run the set for long periods but inevitably, one day, someone is going to forget to switch off and the result could be a house fire. Even a fatal house fire.

I've seen a lot of house fires attributable to faulty TV sets, and I have even seen two fires burst into life as I watched! I am scared stiff about burning houses and have no sympathy for anyone who takes the slightest chance of starting one.

Thanks for that story Peter. It's a salutary warning to everyone — don't take chances with electricity or fire!

Hark, the arc!

I find the next story a bit frustrating, since it tells how the problem was fixed, but not exactly how the problem caused the symptoms in the first place. I am one of those people who are never quite satisfied unless I can say exactly *why* such and such happened!

Anyway this story comes from John Smyth, of Graystanes in NSW, and he tells of a problem that produced the weirdest set of symptoms you've ever heard of. John calls his story 'When the Easy One Gets Mighty Hard' and this is what he has to say:

Normally I repair car audio equipment and VCRs from home. But because TVs use dangerous voltages and are such huge items, quickly filling up my home workshop, I haven't been keen to get involved with them.

However this time it was the family TV set. It seemed the ideal situation — a simple fault along with easy access to parts, circuit diagram and technical support.

I first noticed the fault developing when the set (an AWA C3802 — ML chassis) sometimes wouldn't switch on. Aha! I thought; the flywheel power supply wasn't getting its startup pulse. The power switch seemed like the culprit, when a few days later the TV would only switch on if the power switch was held in for a few seconds.

Then the TV went completely dead. There could be no more messing around. It was time for action...

When one set of contacts in the power switch was measured as permanently open circuit it seemed this would be an easy job. Popping in a new power switch brought the set back to life.

But now it was again switching on intermittently. So there had to be something else involved. It eventually turned out to be resistor R902 going high to 12MΩ instead of its normal 150kΩ.

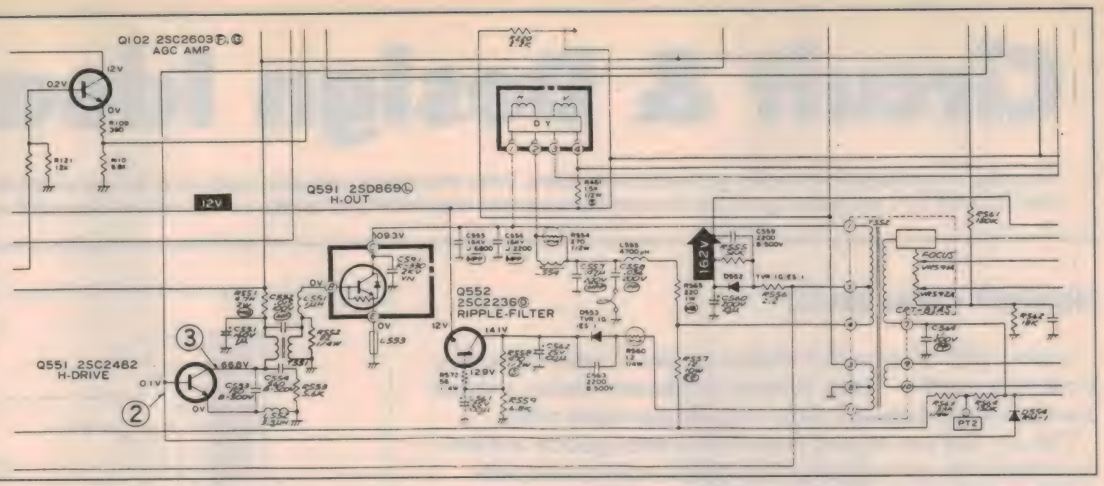
R902, in series with R903, seems to be there to supply power to the start up capacitor C908. In itself a fairly clear cut secondary fault, even if I did go off in the wrong direction a few times. But just when I thought everything was fixed, and was congratulating myself on how smart I was, I noticed something amazing. While testing whether the set would now switch on reliably, I heard an arcing sound coming from the power switch area, about every third time I switched the set off.

It was time to close the curtains and turn off the lights to find the source of the arcing sound. And there it was. Sometimes the arc went from the active terminal to the active terminal and sometimes from the neutral to the neutral terminal, but always on the outside of the power switch.

Now what on earth was going on? Maybe the leads on the switch were too close together. The closest gap was about 4mm, so I tidied up the soldering, applied heatshrink and ended up with a neat 6mm gap between insulation covered pins. And would you believe it? There was still arcing across the outside of the power switch, just as before.

The only thing I could think of was that the new power switch was the wrong type and couldn't handle the back EMF the TV was generating at switch off. Maybe the TV was acting as some sort of giant inductor. But then, maybe the degaussing coils were permanently on? Nope, disconnecting them caused no change at all...

Technical support couldn't shine any light on the problem, other than to agree with me that the giant inductor theory sounded too weird to be true and



The horizontal drive and output section of an AWA C3802 set. Reader John Smyth had one of these sets, which kept on arcing over at the mains switch and/or power point!

that the 4mm uninsulated gap on the power switch shouldn't have caused any problems. "Maybe you've just got a dud switch."

OK, let's try a new power switch, being extra careful to get the job done perfectly with maximum gap between wires on the terminals and heatshrink insulation completely covering the terminals. And, blow me down, it STILL had arcing on the outside of the power switch at switch off, just as before!

It was time to get one thing straight. Could this switch handle the current, or couldn't it?

Assuming the TV to be similar in current drawing capacity to say a 100W bulb, I tested to see if the switch could cope with this magnitude of load. It was OK. Then I tried the bulb connected on the output of an isolation transformer, with the switch in the input, thus simulating the back EMF of a switching-off TV. Once again OK. It was even OK when the switch was used to control a 1200W fan heater on and off. Conclusion: Switch seems OK.

Then having put the whole set back together, I discovered something new. When I switched it on and off at the wall switch, the arcing sound was now coming from inside the wall switch itself!

Well, at least I now knew it wasn't anything to do with the set switch. But where was that high voltage spark coming from? Then the penny dropped...

This arcing at the power switch was a thin blue EHT type of spark, not the fat orange spark that results from switching a normal AC load. It was just like the spark one gets get when one discharges a picture tube before taking out the ultor cap.

Then I noticed some sort of grease around the ultor cap. Could that be it? So I cleaned the ultor cap and the area surrounding it on the picture tube. But that wasn't the problem - the sparks continued just as before.

But I then noticed one other thing. Even after the TV was switched off, and after it had finished sparking across the power switch, I could get a mild tingle by touching the chassis in this now disconnected hot chassis set. Somehow there must be a path for the EHT to travel to the chassis.

So then I hit the jackpot. What would happen if the tripler unit had some kind of internal fault that allowed EHT to come back down the overwinding when the set was switched off, and no longer biased to supply EHT to the TV tube?

And looking at the circuit diagram showed suprisingly little between the overwinding and the mains switch. Maybe the EHT was travelling via the overwinding, then through R564, R563, D906, R903, R902, L901 and the bridge rectifier to the power switch. Notice that in this route is R902, which is the resistor that went high resistance in the fault above.

But then who knows what route the EHT took, considering it could have exceeded the breakdown voltage of nearly any semiconductor junction or any other component in the set.

Indeed as I keep telling myself, our job as technicians is to fix the problem, not to do a complete circuit analysis of the fault. If it was a faulty LOPT then a new LOPT should mean no sparking across the power switch.

And that was it. A new LOPT was fitted and the set was ready for the favourite show of the week, with only an anxious five minutes to spare. That was over two weeks ago and the power switch hasn't arced since.

So what's the moral of the story? For me it is to consider the path the EHT might take (to the power switch or other unrelated circuitry) if the tripler develops a fault, allowing the EHT to discharge back through the LOPT overwinding.

Thanks for that story, John. Uncontrolled EHT is alarming, no matter where in the set it appears. And to find it escaping as far as the wall switch is positively hair raising!

If your set had been fitted with a conventional transformer and tripler combination, an explanation of the fault might have been a little easier. As it is, the newer diode-split transformers are a total mystery inside and often do not agree with the schematic diagram that purports to show their internal connections. Under those circumstances, who could accurately guess what happens under breakdown conditions?

There was one small error in your story, John. C908 is not a 'startup capacitor' as such. It's part of the timing network in the base circuit of a self-oscillating chopper supply. R902 and R903 are there to supply an initial bias to the chopper transistor in IC991. Without this bias the supply can never get going.

These two resistors sit across 345V DC while ever the set is in standby mode. They are not necessarily drawing current during this time, but the constant voltage stress eventually causes failure. This type of circuit is used in dozens of brands and hundreds of models, so it is a quite common fault.

As for the path taken by the EHT in John's story, his guess is as good as any. My guess is that it has something to do with C564, a 0.1uF 200V polypropylene capacitor between the bottom end of the EHT winding and earth. Any breakdown in this capacitor would offer a lower impedance path to the switch than the one John describes.

But then, on second thoughts, my suggestion doesn't explain why the fault cleared when a new transformer was fitted. I don't know. As John mentions at the end of his story, our job is to fix the problem, not to carry out a full circuit analysis. I think I'll leave it right there.

That's all for this month. There'll be more next time. ❖

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

Network cable tester

Almost 70% of network problems are due to faults in the network cable itself — shorts between conductors, breaks and bad connections are common, not to mention mis-wired cables.

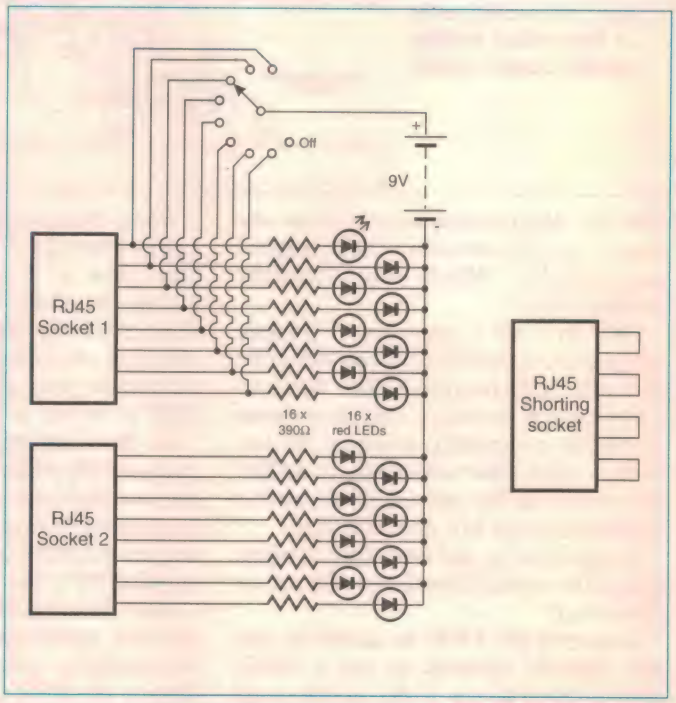
This test unit can be used to test RJ45 cables quickly and easily, and tests for open circuits, short circuits and crossed pairs.

Positive 9V is supplied to the centre pole of a nine position rotary switch (position 1 is not connected, and is the off position). Positions 2 to 9 are connected to pins 1 to 8 of the RJ45 socket, and also connect to a LED and 390 ohm dropping resistor, to indicate the contact under test.

To test for shorts, plug the cable under test into socket 1, rotate the switch through each of the eight positions, and only one of the LEDs should light up. To test for open circuits, plug the second end of the cable into socket 2 and again switch through the eight positions. Only the one corresponding LED on each socket should light.

While testing an installation for open circuits and crossed pairs, you may not be able to get both ends of the cable to the tester at the same time; in this case, simply put the shorting socket on one end of the cable, and check that the two LEDs of the corresponding pair light together.

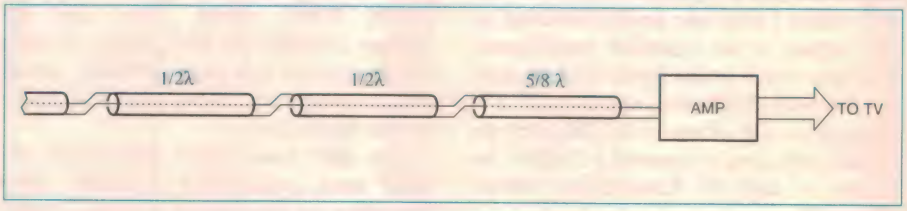
Owen Beckham
Shepparton, Vic. **$35**



UHF TV antenna

This antenna works beautifully in areas with weak and scattered signals. Where we live, TV reception is poor even with a good antenna and a masthead amplifier, so I was looking for a different concept. I decided on a collinear antenna because it is easy to build — it consists only of half wavelength pieces of coax cable. The shield is used to pick up the signal and the conductors are swapped between each element, resulting in the elements being fed in phase. The total number of elements determines the gain.

I fitted my antenna in a PVC pipe of 20mm diameter and 1.8m length which ended up on the window sill next to the TV set.



The advantages of this antenna are that it is unbalanced so no balun is required, and there is little loss in cables due to easy installation.

To build it, cut six pieces of coax cable to half of the wavelength and one piece to 5/8 of the wavelength of your weakest channel (for example 247mm and 379mm for channel seven). Connect all the elements in series, swapping the shield and centre conductors at each junction, with the 5/8 wavelength element on the end that connects to your masthead amplifier. Carefully maintain the coax insulation distance while soldering, and secure everything in place with Araldite. Fit the lot in a PVC pipe and your antenna is finished.

A collinear antenna performs best within an angle of +/-30° to the signal source, so you'll have a lot of flexibility in positioning your antenna.

Marc Kaufmann
Bilgola Plateau, NSW **$30**

Easy removal of components from PCBs

The heat guns that are available from most hardware stores are designed for paint stripping, bending PVC pipe, and shrinking heat-shrink tubing. Also listed among their uses is the tinning and soldering of sheet metal, which suggested to me that they could be used for removing components from PC boards.

In trials to test the idea I desoldered a couple of old boards and was amazed at just how easy and quick it was. I was even more amazed to find that all the components came off unscathed including ICs (even 40-pin ones), discrete semiconductors, resistors, capacitors, LEDs, header strips, etc. All of these parts tested OK afterwards. I have not tried any surface mounted parts myself, but someone I discussed this with reports that this method is better than any other he has used and it can be used to resolder surface mounted parts as well.

I have a Ryobi 1600 watt model PS1600V with two-speed fan and triac controlled heating element. (I have not tried the

fixed speed, uncontrolled 1400W models, but without any heat control I think they would be unsuitable for this purpose.) The temperature of the air flow from my heat gun is stated as being controllable from a low of 120°C to a maximum of 590°C.

60/40 solder melts at just over 300°C and a common soldering iron operating temperature is 370°C, so the gun's range is perfect. I use the low fan speed and about two thirds setting on the heat control to get a column of hot air about 50mm in diameter which is just above the melting point of the solder. It takes about 30 seconds to get the board up to temperature, but once an area has been heated, the adjacent areas are heated in much less time.

The components virtually fall out once the solder has fully melted all the way through the plated-through hole, but you must be patient and wait until the components are loose in the solder, and you must make sure there are no bent pins before pulling the components out. If you use moderate care there is no charring, no blistering, no burnt fingers, no damaged plated-through holes or tracks pulled off.

The components removed using a heat gun are usually ready for immediate re-use without any cleaning up afterwards. However, the boards do need cleaning up with a solder sucker if you want to re-use them, because their holes are still filled with solder. You are still better off though, because just using the solder sucking methods to remove components still leaves the components' pins stuck to the sides of the holes by a thin film of solder — which, with multi-layered boards, risks damaging the delicate plating between layers when the chip is eventually pulled out. Using the heat gun first to remove components avoids this problem.

Rick Matthews
St. Georges, SA $35

Sleep timer for battery powered radio

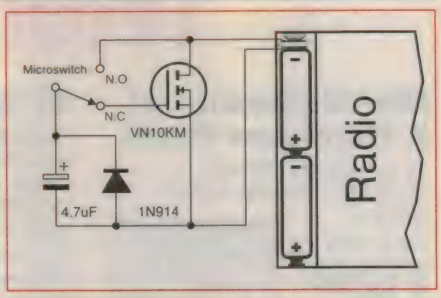
For those who suffer from the annoying habit of falling asleep with the radio left switched on, this circuit will automatically turn off the radio after about 30 minutes. The circuit is very simple, and the four components in it can be scrounged from the junkbox, or bought for around $8.

The timer is started by briefly pressing the microswitch; this charges the 4.7uF capacitor so that when the switch is released, the FET is held on by the capacitor's stored charge. When on, the FET source-drain resistance falls to a few hundred milliohms, and the battery current flows through it, powering the radio.

As the charge in the capacitor leaks away, the FET's gate voltage falls, and the radio eventually turns off.

One interesting point about this circuit is that if the button is pressed while the FET (and radio) is on, the capacitor is discharged instantly through the FET, causing the FET to switch off when the button is released. Pressing the button again recharges the capacitor (as the FET is now off) and the FET turns back on again, thus an on/off toggling action is provided, with an on-time of half an hour. (Not bad for just four components!)

The circuit is connected to the battery compartment by thin, stout multicore wire (selecting the right type of durable wire is probably the most important aspect of this project). The wires are attached to a 10mm square wafer made either from a small piece of double sided PCB laminate, or from two pieces of single sided Veroboard ground very thin and glued together. the wafer slips between any two batteries, or between the battery and its terminal.



Frank Eliason
Weston, ACT $30

THIS MONTH'S PRIZEWINNER!

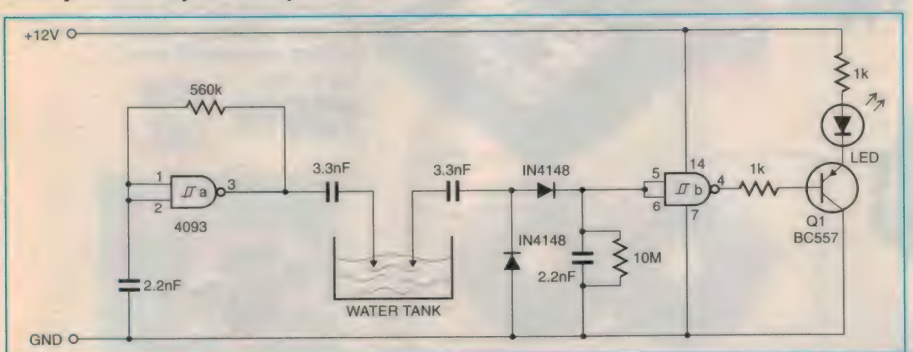
Water level indicator

Electrolytic action between the water and sensing probes is often a concern with simple level sensors, due to the DC potential that is usually present between the two probes. This can result in the negative electrode being slowly eroded by electrolysis.

By using a couple of Schmitt NAND gates wired as inverters, a simple water level sensor can be made that produces an AC voltage across the sensor electrodes, preventing them from being eaten away.

An oscillator comprising U1a, R1 and C1 is connected to one of the sensing probes via a 3.3nF blocking capacitor. This low level signal injected into the liquid is picked up by the second probe, and is rectified by D1 and D2. Capacitor C2 charges up past the trigger threshold of the second gate, turning on the LED via PNP transistor Q1. The 10M resistor R2 serves to tie the gate's input to 0V if the water falls below the level of the probes, turning off the LED.

Pradeep G.
Alappuzha, South India $35 ❖



WIN OUR 'IDEA OF THE MONTH' PRIZE!

As an added incentive for readers to contribute interesting ideas to this column, the idea we judge most interesting each month now wins its contributor an exciting prize, in addition to the usual fee. The prize is a compact CCD video camera module from sponsor **Allthings Sales & Services**, offering 460 TV lines of horizontal resolution and 0.05 lux sensitivity, and valued at $199.00!

DICK SMITH ELECTRONICS

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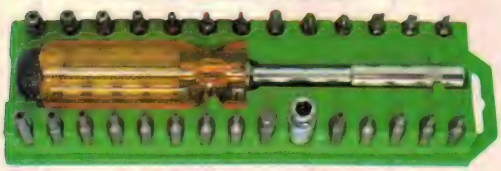

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Consists of a strong driver handle with magnetised tip, 28 various bits, and a handy storage case. Bits include flatblade (3, 4, 5mm), Phillips head (1, 2, 3), Hex (2, 2.5, 3, 4, 5, 5.5, 6), Square (S0, S1, S2, S3), Security torx (T7, T8, T9, T10, T15, T20, T25, T30, T40), as well as a 1/4" adaptor and hex nut socket.

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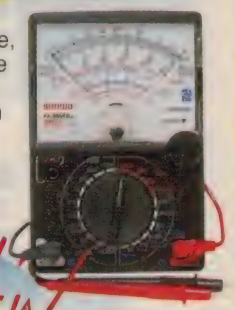

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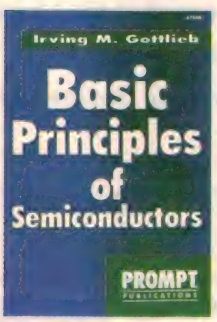

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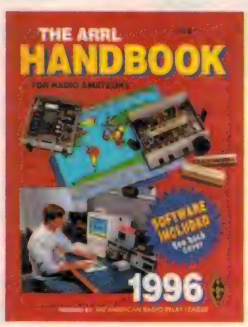

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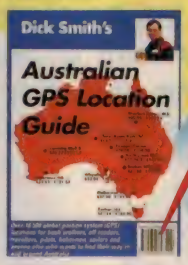

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STORES ACROSS AUSTRALIA AND NEW ZEALAND

Construction Project:

PC-DRIVEN ARBITRARY & FUNCTION GENERATOR - 2

Here's the second article describing our new PC-driven function/arbitrary waveform generator, which can produce signals of virtually any desired waveform at frequencies from 0.25Hz to beyond 100kHz. It doesn't cover the construction of the generator yet (sorry!), but instead explains why the design was delayed — and describes the circuit revisions that have been necessary to overcome the 'bugs' we discovered.

by JIM ROWE

It's with a suitably red face that I sit down to write this article. That's because it's not the originally planned and promised 'second part', describing the generator's construction and use, but really a kind of larger-than-usual 'Notes and Errata' addendum to the first article which appeared in our December issue.

I have to confess here that at the very time that the December issue had to go off to the printer, continued testing of the prototype generator with alternative RAM chips and different computer printer ports had revealed some strange 'glitches' in its performance. But although the problems were puzzling and their exact causes still unresolved, they seemed to be of a 'second order' nature and likely to require only minor changes in either component values or software, to fix them. Because of this I elected to 'take a punt' and let the first article run, instead of pulling it out and delaying both the project and the December issue.

With the benefit of hindsight, that was the wrong decision. Further testing showed that the causes of the problems were much harder to track down than I had believed — largely because of the way that the generator involves an almost symbiotic combination of hardware and software. Not only that, but when the causes *were* finally tracked down, the only really acceptable way to solve one of them turned out to involve quite significant changes to the circuitry, the main PCB and the software!

At this point I would like to thank my colleague Graham Cattley, who played a key role in tracking down the causes of these problems. When I became 'bogged down' in the project and seemed to be getting nowhere fast due to the MEGO ('my eyes have glazed over') factor, Graham volunteered to take over for a while. His younger mind and fresh approach soon identified exactly where the problems lay, and I'm very grateful for his help.

After that, it didn't take *too* long to make the necessary changes to the circuit and software, and test them out. This has now been done, and the new design com-

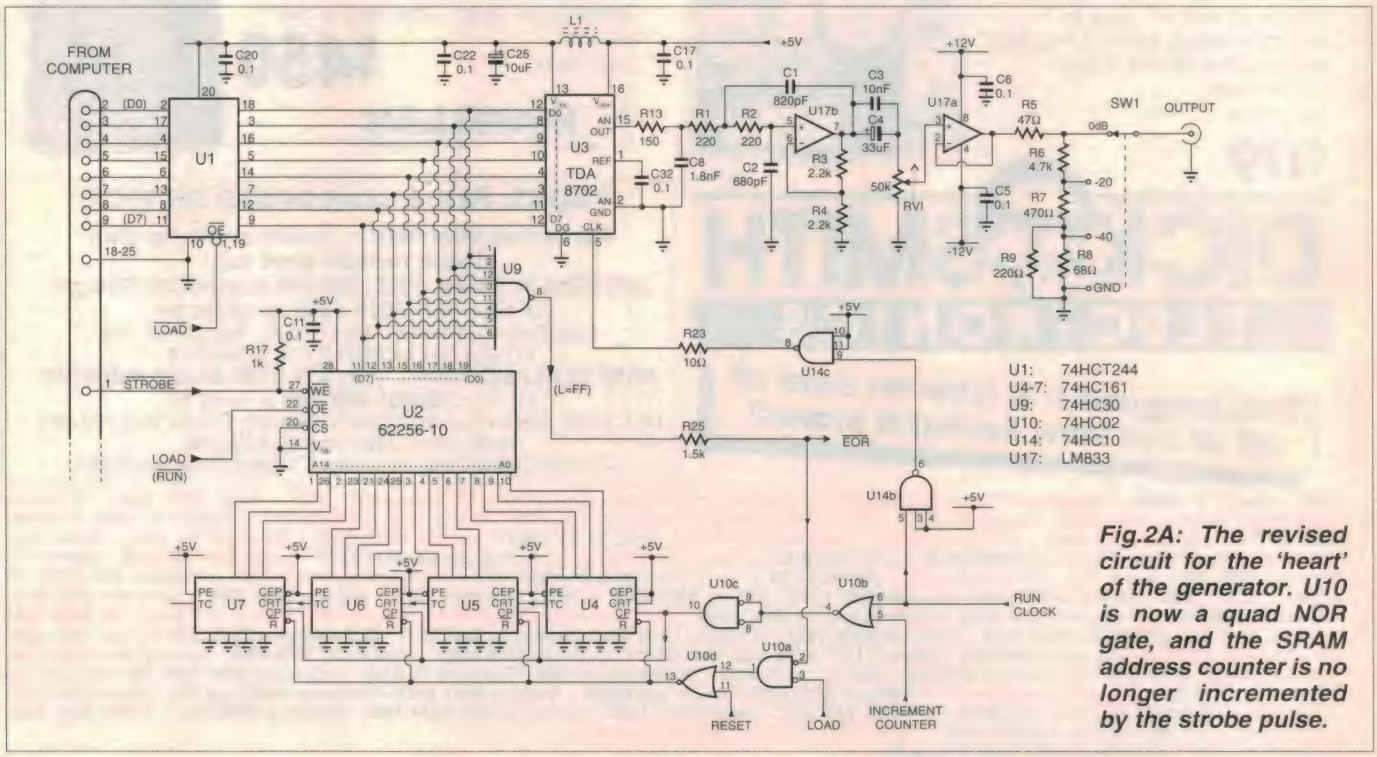

Fig.2A: The revised circuit for the 'heart' of the generator. U10 is now a quad NOR gate, and the SRAM address counter is no longer incremented by the strobe pulse.

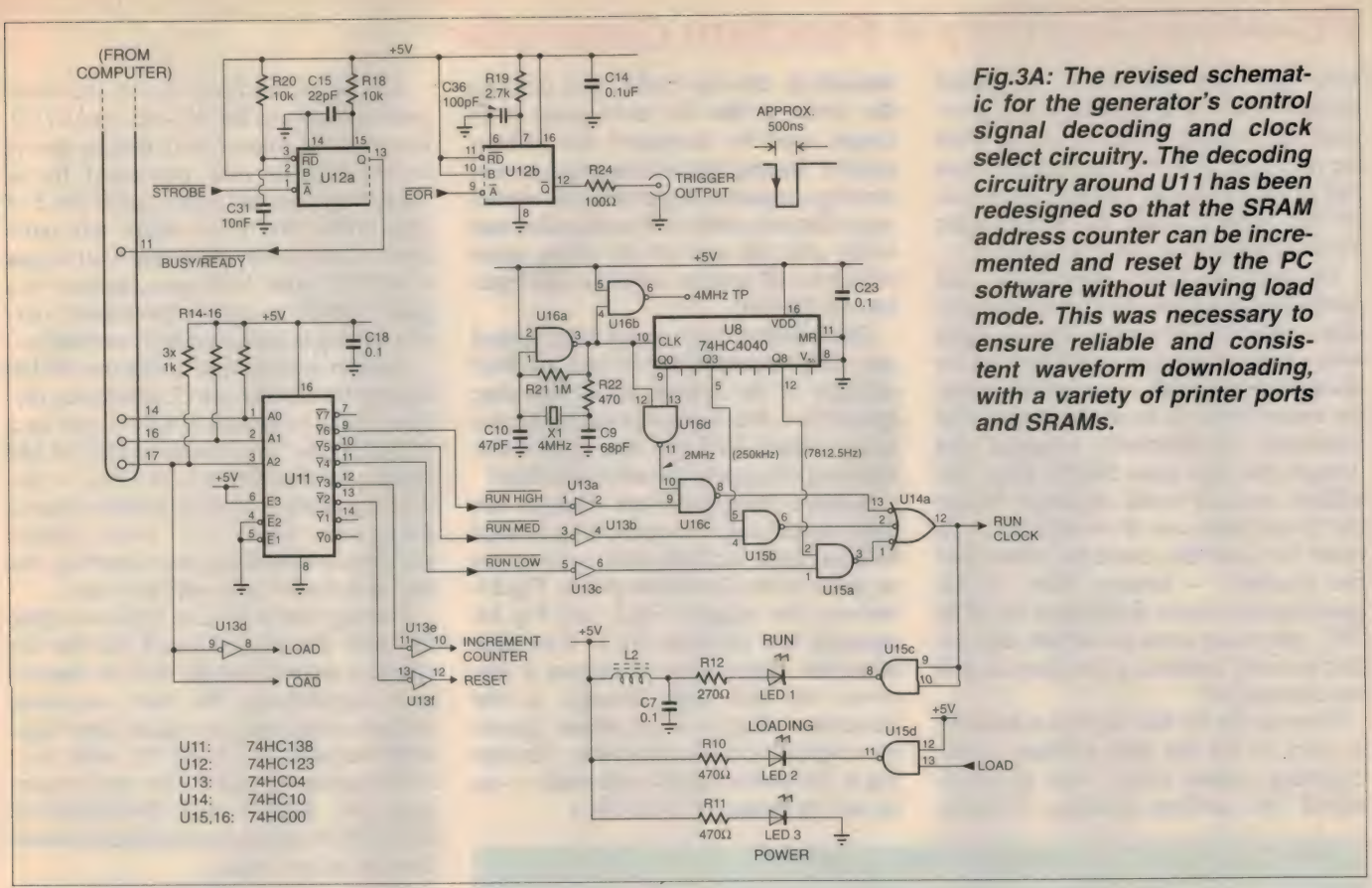

Fig.3A: The revised schematic for the generator's control signal decoding and clock select circuitry. The decoding circuitry around U11 has been redesigned so that the SRAM address counter can be incremented and reset by the PC software without leaving load mode. This was necessary to ensure reliable and consistent waveform downloading, with a variety of printer ports and SRAMs.

pleted for the main PCB.

I must apologise, though, for publishing the first article before all of the project's 'bugs' had been found and removed.

The bugs and fixes

But what *were* these strange problems, and how were they fixed? I'll try to summarise what turned out to be a very long and frustrating story, albeit with a happy ending...

One problem was that with *some* static RAM chips, and with some waveforms, the generator wouldn't 'play' the complete waveform for signals that were *lower* than a certain frequency. It would play a truncated version of the waveform — for example sinewaves of less than about 55kHz suddenly turned into 'rounded sawteeth' of about four times the frequency, as the generator only 'played' roughly the first quarter of the downloaded waveform record.

What was really confusing about this problem, though (and also misleading), was that *other* waveforms would apparently 'play' quite normally, at all frequencies we tried...

Another problem, again with some SRAMs and especially with some computers and their printer ports, was that when some waveform records were downloaded, they'd produce signals with 'flats' or small 'spikes' at the start of each cycle. Very occasionally they'd even refuse to play at all, or the generator would seem to ignore the downloaded waveform file and produce a strange signal at the 2MHz clock rate.

This second problem was also quite inconsistent, in the sense that quite often (at least with *some* SRAMs and printer ports), downloading the same waveform file again from the computer would result in the waveform being generated normally!

Without trying to retrace all of the steps we had to take to track them down, here's what we finally found.

You may recall from the first article that the generator uses a 'poor man's DDS' technique, where a digital record corresponding to a single cycle of the desired waveform is downloaded into the SRAM (U2). The generator is then made to automatically play this record over and over again to produce the signal, by having the SRAM's address counters reset to zero each time it reaches the end of the record. This is done by adding an 'end of record' (EOR) marker byte to the end of each record; the EOR marker is an 'FF' byte, which is detected by 8-input NAND gate U9.

Well, the truncated waveform problem turned out to be due to *some* SRAM chips producing false and very short 'FF' output glitches, at particular changes of address — presumably at the end of an internal row or column of cells. Although very short, these glitches were just able to trigger the FF detector chip U9, and cause premature resetting of the address counters. Hence the truncated waves...

What made this one especially hard to track down was that the glitches only seemed to appear at the SRAM output when particular data bytes were stored in the critical memory locations. That's why the problem only appeared with some waveforms.

The cure was to fit a low value resistor (1.5k) in series with the output from U9, to form a low-pass filter in conjunction with the input capacitance of the following gate. This effectively 'swallows' the very narrow glitch spike, which having no appreciable effect on the 'real' reset signal generated by U9 in response to the EOR marker byte. The added resistor is shown as R25 in Fig.2A, the revised version of the schematic for the 'heart' of the generator.

The second problem turned out to be even harder to track down than the first. Ultimately we found that all of its puzzling symptoms were caused by different aspects of a subtle timing problem, which could occur during downloading of the waveform record.

My original idea was to use the strobe pulse from the PC's printer port to both

PC-driven Arbitrary & Function Generator

write each data byte into its designated location in the SRAM, and then also increment the memory counters ready to write the next byte. The idea was that the main part of the active-low strobe pulse would do the writing, while its trailing edge would increment the address counters.

On paper, the timing seemed OK, and on the first prototype (tested with a particular computer), it worked fine — even with a long extension printer cable. But we discovered that with some printer ports, the trailing edge of the strobe pulse could sometimes be effectively extended *just enough* that with some SRAM chips, the address counters could increment before the SRAM came out of write mode. As a result the same data could be written into two locations — causing 'flats' on the generated waveform. Sometimes the EOR 'FF' byte could even be written into the first memory location, to produce no real waveform at all.

Even the fix for this one was not nearly as easy as for the first problem. After exploring various ideas, none of which solved the problem reliably, I finally decided to 'bite the bullet' and redesign the circuit so that the strobe pulse is no longer used to increment the address counter. Instead the incrementing is now done by a separate output from the control signal decoder, under software control and safely after the end of the strobe pulse (which is still used to write the data bytes into the SRAM).

This solution may sound both logical and straightforward, but it has involved redesign of the control signal decoding around U11, the clock pulse and reset pulse gating around U10, and also quite a few matching changes to the software. Phew!

Because these hardware changes are fairly significant, I'm presenting revised versions here for both main schematics as given in the December article. Fig.2A replaces the original Fig.2, and Fig.3A replaces the original Fig.3. I've also taken the opportunity to correct a few errors that had crept through, in the December diagrams, so please ignore the original versions altogether. (Except Fig.4, the power supply schematic — as far as I'm aware, it's still OK.)

PARTS LIST

Resistors

R1,2	220 ohms 1% MF
R3,4	2.2k
R5	47 ohms
R6	4.7k
R7,10,11	470 ohms
R8	68 ohms
R9	220 ohms
R12	270 ohms
R13	150 ohms 1% MF
R14,15,16,17	1k
R18,20	10k
R19	2.7k
R21	1M
R22	470 ohms
R23	10 ohms
R24	100 ohms
R25	1.5k
RV1	50k linear pot

Capacitors

C1	820pF styro or ceramic
C2	680pF styro or ceramic
C3,31	10nF monolithic
C4	33uF 16VW tantalum
C5,6,7,11,12,13,14, 16,17,18,19,20,21, 22,23,24,32	0.1uF monolithic
C8	1.8nF MKT
C9	68pF NPO ceramic
C10	47pF NPO ceramic
C15	22pF NPO ceramic
C25	10uF 10VW tantalum
C26	2200uF 10VW RB electro
C27,28,33,34,35	220uF 16VW RB electro
C29,30	100uF 10VW RB electro
C36	100pF NPO ceramic

Semiconductors

D1,2,3,4,5,6	1N4001 power diode
LED1,3	3mm diameter LED, red
LED2	3mm diameter LED, green
U1	74HCT244 octal buffer
U2	62256-10 32K x 8 SRAM
U3	TDA 8702 video DAC
U4,5,6,7	74HC161 synchronous four-bit counter
U8	74HC4040 binary counter
U9	74HC30 octal NAND gate
U10	74HC02 quad 2-input NOR gate
U15,16	74HC00 quad 2-input NAND gate
U11	74HC138 decoder
U12	74HC123 dual one-shot
U13	74HC04 hex inverter
U14	74HC10 triple 3-input NAND gate
U17	LM833 dual op-amp
U18	7805 +5V regulator
U19	7812 +12V regulator
U20	7912 -12V regulator

Switches

SW1	2 x 4-way rotary switch

Miscellaneous

L1,L2	Choke: 8T on F29 ferrite bead
X1	4MHz crystal, HC-49/U
T1	Power transformer, 240V to 12.6V CT @ 150mA

1 x plastic instrument case, 200 x 160 x 65mm; 2 x PC boards, single sided, one 114 x 51mm (97afg3a), the other 137 x 117mm (97afg3b); 13 x 2 strip of 0.1" spaced DIL pin header strip; matching header plug (IDC), with length of 25 or 26-way ribbon cable and DB25 IDC plug for computer end; 1 x 28-pin DIL socket (0.6" spacing); 1 x 16-pin DIL socket; 2 x BNC sockets, single hole panel mount (one insulated); 2 x instrument knobs; IEC captive mains plug, panel mounting; mains fuse holder and 500mA fuse cartridge; 23 x PCB terminal pins; small piece of 1mm aluminium sheet for transformer mounting plate; short length of light coaxial cable; hookup wire, solder etc.

As you can see from Fig.2A, the strobe pulse still goes to the WE-bar input of U2. However the counter incrementing during downloading is now performed by an 'increment counter' pulse, fed to pin 5 of gate U10b. We'll see where this pulse comes from shortly. Note that U10 is now a 74HC02 quad NOR gate, instead of a quad NAND, to achieve the correct logic functioning in both load and run modes.

Another point to note is that the OE-bar input of the SRAM, pin 22, which was previously tied to ground, is now driven by a LOAD signal. This ensures that the SRAM outputs are disabled in load mode, to prevent any possible conflicts with the outputs from write buffer U1. We're unsure whether such conflicts *were* occurring, but this mod should make sure they can't.

Turning now to Fig.3A, if you compare this with the original you'll see that the circuitry around decoder U11 is changed quite significantly. The three run-mode control signals are now taken from high-order outputs Y4, Y5 and Y6, while low-order outputs Y2 and Y3 are used to generate the RESET and INCREMENT COUNTER signals for the SRAM address counter, in load mode.

At the same time, the LOAD-bar control signal is now taken from the most significant of the three control signals from the printer port, which now arrives on pin 17. Inverter U13d is used to generate the complementary LOAD signal, used to feed to U10a and the SRAM's OE-bar input.

The nett effect of these changes is that the incrementing of the SRAM's address counter is now fully under software control and correctly timed, along with the reset function, when the generator is in load mode. Importantly the generator also remains in load mode *during* the increment and reset operations — which couldn't be done with the original circuit configuration.

In redesigning the PCB, I've also taken the opportunity to add capacitor C36 to the trigger output one-shot circuitry around U12b, to give a wider trigger pulse (around 500ns).

So that's the reason for putting this project 'on hold' for a month, and how its bugs were found — which altogether took a lot longer than I expected. The project is now 'a goer' again, though, and I believe you'll find it worth the wait. It really is a very flexible instrument, able to generate a huge range of both standard and 'special' waveforms. Especially now that it's finally working properly...

In the third of these articles, we'll look at its construction and testing, and perhaps start showing how it's used. ❖

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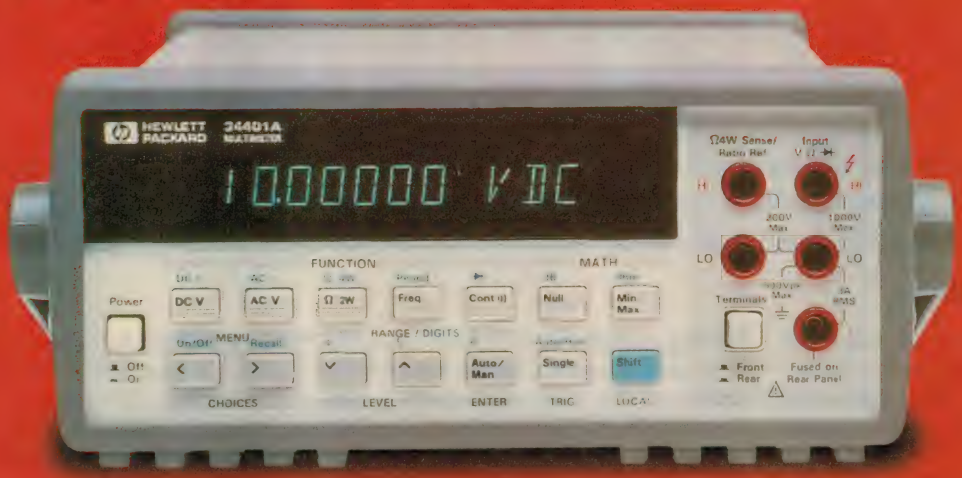

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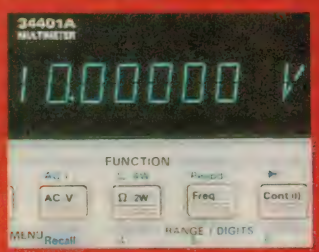

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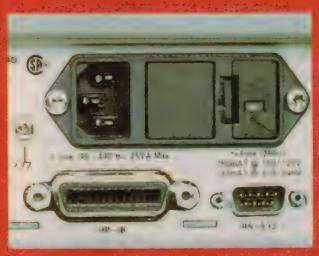

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Construction Project:

LOW COST VEHICLE OVERSPEED MONITOR

This simple project gives a warning if your vehicle is exceeding a preset speed. The speed 'limit' is set by a potentiometer, which is mounted for ready access so you can change it for different circumstances. It's easy to build and install, and costs a small fraction of a speeding fine...

by PETER PHILLIPS

Most cars these days are so quiet and smooth that it's very easy to exceed the speed limit without realising it. This is particularly true on long journeys where good quality roads stretch 'forever' into the distance. Throw in some music or other distractions, and before you know it, blue lights are flashing and sirens are sounding. Caught, when you least expected it!

Some cars are fitted with a cruise control, which will automatically maintain a preset speed and help eliminate the prospect of a speeding fine. But if your car doesn't have such an feature, you need to keep a constant watch on the speedo — which makes the journey that much more tiring.

This little project from Oatley Electronics won't keep the car at a constant speed, but it *will* warn you if you are exceeding a preset speed. The speed threshold is set by a potentiometer, which can be mounted on the dash, or fitted to the case holding the electronics. You can calibrate the settings, or simply set the pot while driving so the speaker sounds say at 110kph. Then you can rest easy driving at 100kph, knowing the unit will warn you if your speed creeps up to 110kph or more.

The sensor for the unit is a small PCB holding a Hall effect sensor. Two tiny 'rare earth' magnets are attached to the tail shaft or a wheel hub, with the PCB positioned so the magnets produce pulses from the sensor. Because of the strength of the magnets, the sensor can be mounted up to 10mm from the magnets, so positioning the sensor PCB is not critical.

Three wires connect the sensor PCB to the main board, and the only other external connections are +12V and ground. We'll have more to say about the external wiring, but first let's take a look at the circuit.

Circuit details

Each time a magnet passes the Hall effect device, it produces a positive-going pulse. These pulses are coupled through diode D1 to the input of NAND gate IC1d, which together with IC1c, form a monostable. Each pulse triggers the monostable, with the output of IC1c going high for a period determined by R3 and C1. The monostable output is therefore a series of pulses with a preset duration.

The output from IC1c is fed to the integrating network of C2 and R4, which produces a voltage that is directly proportional to the road speed of the vehicle. In effect, C2 is charged to a voltage proportional to the number of pulses from the monostable, increasing as the pulse rate increases. This voltage goes to the non-inverting input of IC2, an op-amp wired as a comparator. The other input to IC2 is a voltage determined by the setting of VR1 — the potentiometer used to set the speed at which the alarm sounds.

Comparator IC2 compares the voltage across C2 to the voltage set by VR1. If the voltage across C2 is higher than the voltage at the wiper of VR1, the output of IC2 will switch high. This enables the low frequency oscillator based on IC1a. The frequency of oscillation is determined by C3 and R10. The duty cycle of the oscillator is set by R9 and diode D4 to 30% (i.e., the output is high for 30% of the time).

When the output of IC1a (pin 3) goes high, it enables the high frequency oscillator around IC1b. This oscillator operates at about 3kHz, set by R11 and C4. The output of IC1b then drives transistor Q2, which in turn operates the speaker (or piezo device), producing an alarm tone that indicates an overspeed condition.

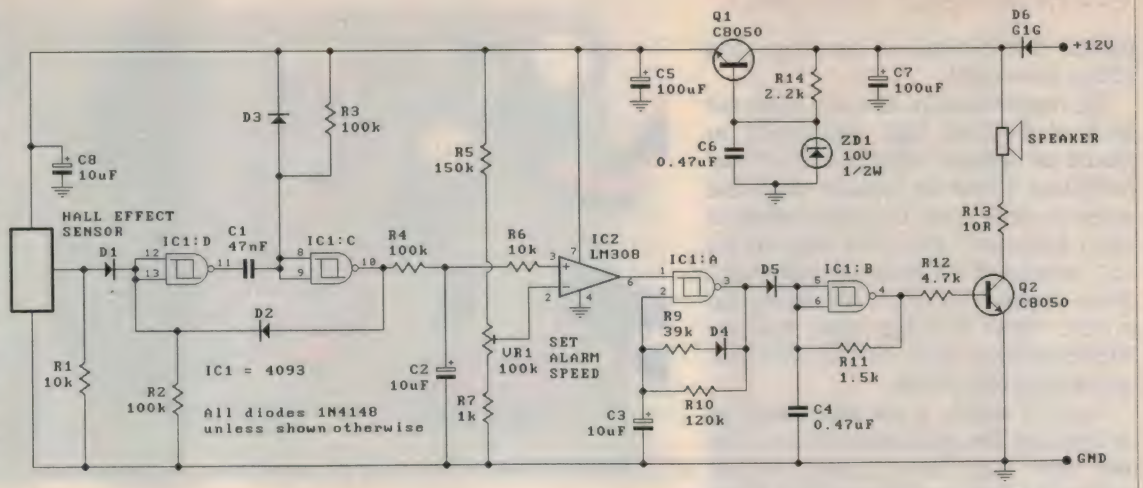
The voltage to the circuit is regulated by Q1 to around 9.4V. The 10V zener diode ZD1 and R14 hold the base of Q1 at 10V, giving 9.4V (or so) at the emitter of Q1. The 12V supply to the circuit is fed to the regulator via D6, which provides reverse polarity protection. Filtering is provided by C7 and C5, with C8 mounted near the Hall effect sensor to provide extra filtering of the DC supply to the sensor.

Construction

As explained, there are two printed circuit boards: one for the main electronics, the other for the sensor. If you purchase a kit of parts (see end of article for details), you'll receive silk-screened, solder-masked boards showing component placement. In any case, the layout diagram and photos show where all the components go.

Starting with the main board, as usual,

This simple unit produces a pulsing alarm signal to indicate that you're exceeding a preset speed limit. The speed is set by the potentiometer.



The Hall effect sensor supplies pulses to the one shot formed by IC1c and d, whose output is integrated by R4 and C2 to give a voltage proportional to speed. If this voltage exceeds that from VR1, comparator IC2 enables the oscillators using IC1a and IC1b, causing the speaker to sound.

mount all passive components first, including the one wire link. Take care with the polarity of the diodes, electrolytic capacitors, transistors and the zener diode. IC sockets are supplied in the kit, although you can solder the ICs directly to the PCB if you wish.

A dynamic speaker is supplied with the kit, which is connected with hookup wire to the board. If you want to use a piezo device, connect a 220Ω resistor in parallel with the device to discharge it between pulses. The potentiometer supplied with the kit can be mounted directly on the board, or linked with suitable wire to the board if you want to place the potentiometer away from the electronics.

Now for the sensor board. There are only two components to mount: capacitor C8 and the Hall effect sensor. The pinouts of the sensor are shown in Fig.1. The sensor is mounted with the chamfers facing away from the board, as shown on the layout diagram. Mount the device about 5mm above the board, then bend the leads so the sensor is horizontal. Make sure the polarity of C8 is correct.

Before testing, check your work to make sure all components are in place, properly soldered and that there are no solder bridges between tracks.

Testing

Before fitting the unit to a vehicle, bench test it first. To do this, connect the sensor board to the main board and apply 12V DC to the main board. The easiest way to get an input signal is to use a portable electric drill with the two magnets taped to the chuck or a suitable drill bit. (The magnets are placed on opposite sides.)

Then hold the drill so the magnets are with 10mm of the sensor, and let the drill run. You should be able to set the potentiometer so the unit gives a signal at a particular drill speed. At this stage don't worry about calibration, just confirm that the unit works.

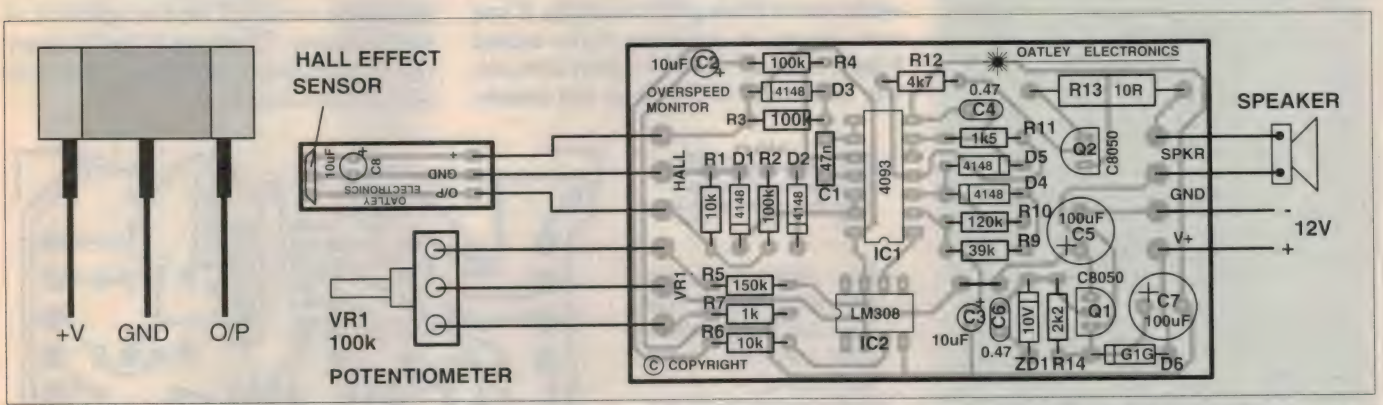
If the unit doesn't work, measure the voltage across C2 and confirm that it varies with the speed of the drill. Expect a voltage variation of from 0.05V to 3.8V or so. If this voltage is changing correctly, connect a link from the 9.4V rail of the circuit to the positive terminal of C2. This will enable the low frequency oscillator, which in turn enables the high frequency oscillator. If the oscillators are working, you should hear a series of beeps.

Installation

The main electronics can be fitted inside a plastic case that is mounted in a suitable position within the vehicle. You'll need to drill a hole for the potentiometer, exit holes for the wiring and perhaps a grid of holes for a speaker grille. If you elect to mount the potentiometer away from the electronics, you'll need to fasten the board inside the case, perhaps with double-sided tape or dobs of silicone glue.

The case should be mounted so the speed setting control is accessible while driving. Also you should mount the case so you can hear the speaker above any road noise.

We recommend encapsulating the sensor board in epoxy resin or silicone glue, to protect it from damage. This board mounts under the vehicle, and can be connected to the main board with four wire telephone cable, or similar. The sensor should face the magnets, and is



At left are the pin connections of the Hall effect device. The chamfers should face away from the board. The layout at right shows the component placement and the interconnections between the two boards. The pot can be mounted on the board, or connected with leads. Note that due to a last minute change, resistor R8 has been deleted.

placed at a distance of no more than 10mm from them.

The magnets can be attached to the tail shaft or a wheel hub, and should be placed on opposite sides to prevent any imbalance. Clean the surfaces where the magnets are to go, then glue them in place with epoxy glue. The magnets are very strong and will probably hold themselves in place, but glue will ensure that a stone won't dislodge them. Run the interconnecting cable so it's well protected from road debris.

The 12V supply to the unit should be switched by the ignition, and fused. The unit takes very little current, so just select the most convenient supply point. The negative supply lead connects to the vehicle's body. Make sure this connection is to bare metal.

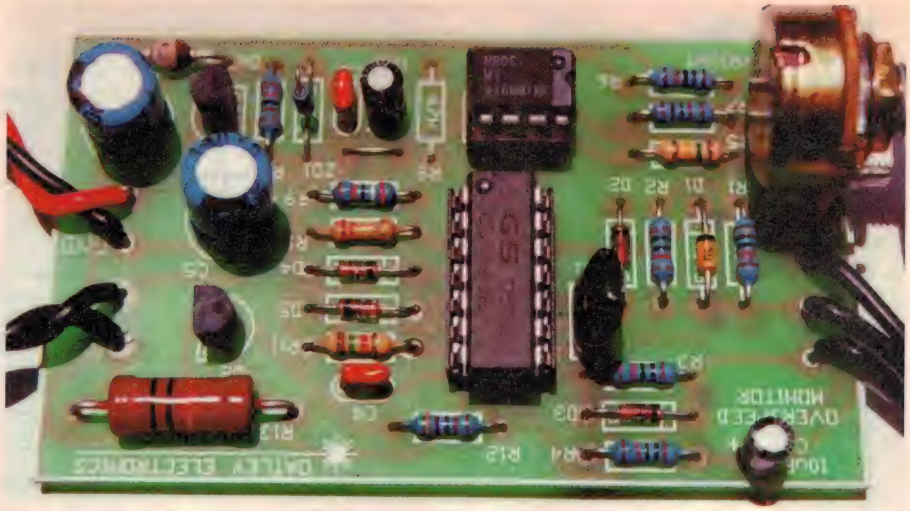
Calibration

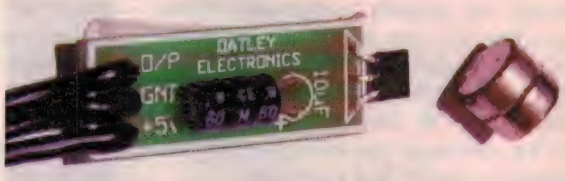
Once the unit is installed, all that remains is to check its operation. The component values in the circuit have been chosen to suit most vehicles, but it's not possible to accommodate all situations. If you find the unit doesn't have enough range, you will need to change a resistor value.

The two choices are either R5 or R3. Remember, the voltage across C2 is proportional to the pulse input rate (and vehicle speed). If the pulse input rate is too high, the voltage across C2 will exceed the range available for the potentiometer. In this case, reduce the value of R5 (try 33k) to increase the voltage range across VR1. Or reduce the value of R3, to decrease the pulse width from the monostable...

There are two ways of using the unit. The first is to calibrate the potentiometer with a suitable scale. While someone drives the vehicle at a preset speed, turn the control so the alarm sounds at that speed. Then mark the scale with that speed, and do the same for other speeds.

Or you might prefer to set the control while you're driving. For example, if you want the unit to warn you if you exceed 80kph, drive at 85kph for a short time, setting the control so the alarm just sounds. Thereafter you will get a warning when your speed is 85kph or more.





Above is a closeup of the main board, showing where the components go. Also see the layout diagram for further details. At right is the sensor PCB and the magnets. Notice how the sensor IC is bent at right angles to the board.

Other applications

Although intended for vehicle speed monitoring, this unit does have other applications. For instance you could use it as an overspeed indicator for any rotating shaft such as a variable speed motor, lathe or similar machinery. Because the magnets are so tiny (6mm dia x 2mm), they can be fitted to virtually any rotating object to sense that the object is in fact rotating. For example a pump at the bottom of a well...

You could also use it to get an indication of speed, by monitoring the voltage across C2. For example, the magnets could be fitted to the fan of a wind speed indicator and the voltage across C2 used as indication of wind velocity. There are probably many other possibilities as well, but that's up to your imagination. ❖

PARTS LIST

Resistors

R1,6	10k
R2,3,4	100k
R5	150k (see text)
R7	1k
R9	39k
R10	120k
R11	1.5k
R12	4.7k
R13	10 ohms 2W
R14	2.2k
VR1	100k PCB mount pot

(Note: There is no R8)

Capacitors

C1	47nF polyester
C2,3,8	10uF 25V electrolytic
C4,6	0.47uF monolithic
C5,7	100uF 25V electrolytic

Semiconductors

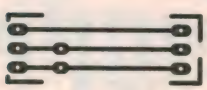
IC1	4093 quad NAND
IC2	LM308 op-amp
Q1,2	C8050 NPN transistor
ZD1	10V 330mW zener diode
D1-5	1N4148 signal diode
D6	G1G power diode

Miscellaneous

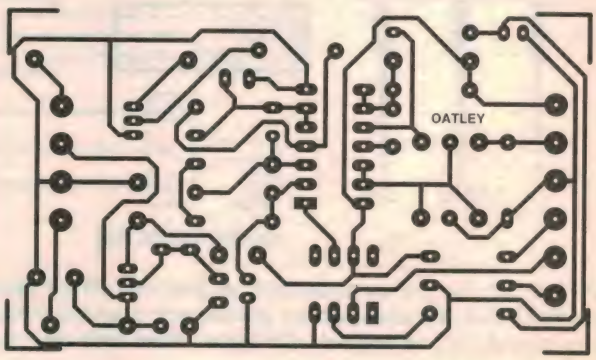
PCB 45 x 77mm; PCB 10 x 26mm; Hall effect sensor; two rare-earth button magnets; piezo or suitable small speaker; control knob; 130 x 68 x 41mm plastic case (optional); 8-pin IC socket; 14-pin IC socket; hookup wire.

Kit available:

A kit of parts for this project is available from Oatley Electronics, of PO Box 89, Oatley NSW 2223. Phone (02) 9579 4985, fax (02) 9570 7910.
Price of the kit, including all components, PCBs, speaker, magnets and knob for potentiometer is $22 plus $3.50 P&P. A suitable plastic case is $3.50.



The PCB patterns are reproduced full size for individuals who want to make their own.



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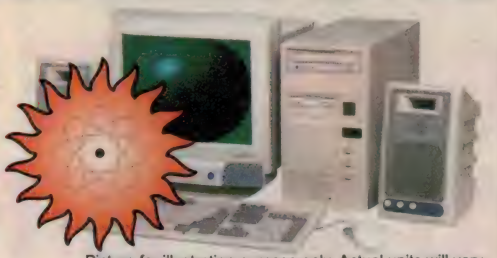

Picture for illustration purpose only. Actual units will vary.

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READER INFO NO. 11

New PLL 'building block' modules let you

GENERATE SIGNALS AT HF, VHF OR UHF - 2

Here's the next article in the author's short series describing two new compact and flexible phase-locked loop RF modules which can be used to form the heart of a variety of RF signal sources for the HF, VHF or UHF spectrum. In this episode he describes how the modules are programmed, how they're assembled and how they can be driven from one of his YADDS-1 synthesiser modules.

by TIBOR BECE

The driver programs for the YAPLL modules are called 'YAPLLV.EXE' and 'YAPLLU.EXE'. The drivers, and their source code in C, are available from the EA BBS in the file 'YAPLL.ZIP'.

Before running the programs, connect the YAPLL module to a PC printer port, as per the block diagram given last month in Fig.3. The software is preconfigured to drive the PLL modules connected to LPT2, at a hex address of 278H. For other printer port addresses, the programs have to be recompiled (to find out the port address of your actual printer port, run 'MSD.EXE', the utility that comes with DOS). A different printer port address is specified by changing the line:

int lpt_base=LPT2

near the beginning of the program to the required LPT1 or LPT3, and recompiling the code.

While we're still setting up things, another thing to check out is the polarity of the phase detector. If the optional active low-pass filter is bypassed on the boards, which effectively inverts the error signal, change the PD_TRUE part in the lines:

PLL_C = PD_TRUE | SEL_PB (VHF)

PLL_C = PD_TRUE | SEL_PA (UHF)

to read 'PD_INVERT'. Refer to the IC data sheet for more details on programming the PLL ICs.

Table 1 shows the bit allocation of the C register, for the MC145170 and MC145191 respectively.

Now type 'yapllv' or 'yapllu'. The drivers have a simple text-mode, command line orientated user interface — no fancy windows or setup files. Because the source is available, it is assumed that everyone will tailor the appearance of the program to their individual needs. A small help window is available by keying in '?[CR]'. The screen of the VHF version looks like Fig.7.

The programs will drive a DDS/PLL combination, as shown in Fig.3, without any setup — just type in the new desired output frequency. They will also drive stand-alone YAPLL modules. In this case,

Fig.7

```
C:>yapllv

** DDS/PLLV driver: YADDS-1 driven YAPLL-V **

*>?
*>Available commads:
  [f]<new frequency,MHz> ('f' is optional)
  o<new frequency offset,MHz>
  r<new PLL 'R' value>    (set PLL reference divisor)
  c<new PLL 'C' value>    (set PLL config byte in hex)
  x<new PLL xtal frequency> (also nominal DDS output!)
  h<hop MHz>              (check PLL transient response)
```

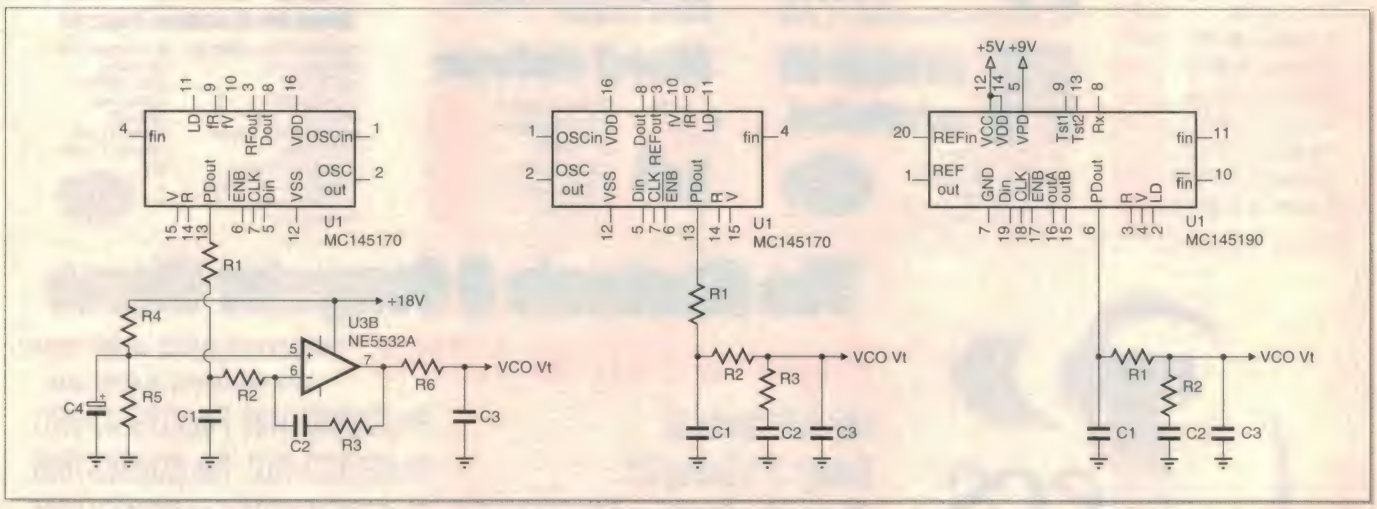


Fig.6: Some of the loop filtering options available on the YAPLL-V and YAPLL-U boards. Left and centre are active and passive filtering on the VHF module, while at right is passive filtering on the UHF module.

the output frequency will be the integer multiple of the PLL reference frequency which falls closest to the desired output.

The first command in this case should be to tell the driver the exact frequency of the crystal on board (in MHz) and specify the desired 'R' division to obtain the required PLL reference. For example, if a 10MHz crystal is fitted and 100kHz PLL reference is required, the commands are:

***>x10**

***>r100**

After this setup, to specify a new desired output frequency, type:

***>f145.0**

The PLL module output should be a clean 145.0MHz signal. Note that the program has no way of knowing which VCO block is being used — the specified frequency should simply be within the operating range of the VCO you're using.

To specify a frequency offset, for example if the PLL module is used as a LO signal, type

***>o-10.7**

Now the output frequency will be 10.7MHz lower than what an 'f' command would normally produce. Once specified, the frequency offset is active for all successive 'frequency' commands. Note that a negative offset specifies 'low side LO', while a positive offset is for 'high side'.

A utility to check the PLL module transient response is the 'h' command. This causes a fast 'frequency hop' between two frequencies, 'f' and 'f+hop'. Monitoring the VCO control voltage gives a fair idea of the PLL transient response — there should be no or little ringing on the control voltage line.

For the UHF PLL module an additional command is available:

***>i50**

this will set the charge pump current to 50% of the nominal value of 2mA. The charge pump current can be set between 25% and 100%. The effect of changing the charge pump current is to change the loop gain of the system, which in turn affects the PLL dynamic behaviour. The default setting for the charge pump output current is 100%.

TABLE 1: PLL Chip Register C bits

MC145170								
	D7	D6	D5	D4	D3	D2	D1	D0
	POL	PA/B	LDE	Osc2	Osc1	Osc0	FvE	FrE
MC145191								
	D7	D6	D5	D4	D3	D2	D1	D0
	POL	PA/B	LDE	Stdby	I2	I1	I0	OutB

Loop filter design

Many excellent textbooks and articles have been written on analysing and designing PLL systems. Instead of going too deeply into theory here, I'll present just a bare-bones practical guide on how to select the loop filter components, if a different PLL reference frequency or switching speed is required.

In the following example, let us assume that a POS-75 VCO block is fitted to a YAPLL-V module, and the module is used as the first LO of a wideband shortwave receiver, requiring a frequency step of 5kHz. No external DDS reference will be used, simply because if one was used, there would be no need to change the loop filter values in the first place!

Let us start with the desired phase comparator reference frequency — this will be the PLL output step size. For the YAPLL-V board, this can be set as low as 2kHz and as high as 2MHz (for fref=1kHz, the maximum output frequency will be limited by the maximum 'N' of the MC145170 to fmax = 65.535MHz). In our example, the PLL reference is fref = 5kHz. By the way, if a 10MHz clock is used, the required 'R' divisor will be R = 2000.

Next select the desired loop natural frequency, and denote it as fn. As a rough guide, the loop settling time will be three cycles of the loop natural frequency. For fn = 1kHz, the loop will settle in 3ms; for fn = 10Hz it will take almost half a second. The closer the loop natural frequency to the PLL reference, the more difficult it is to avoid spurious frequency modulation of the carrier that shows up as low level sidebands, known as 'reference spurs'. A good start for fn is 1/50th of the PLL reference.

For a 100kHz reference, a 2kHz loop natural frequency is a practical value — the component values shown on the circuit diagrams of Figs.1 and 2 are dimensioned like this. In our example, let us settle on 100Hz, which will give us roughly 30ms settling time.

Finally, pick a constant, denoted by KM, which will determine how 'damped' the PLL will be in its response to a disturbance. The range for this constant is 2.5 - 5, and the higher the value the 'tamer' the loop will be. This constant directly determines the 'phase margin' of the loop; generally the bigger the margin, the more stable the loop becomes. In our example, let us select KM = 3.

Now we are ready to start determining the actual component values. The corner frequency of the RC time constant R15/C12 is set for KM times the loop natural frequency:

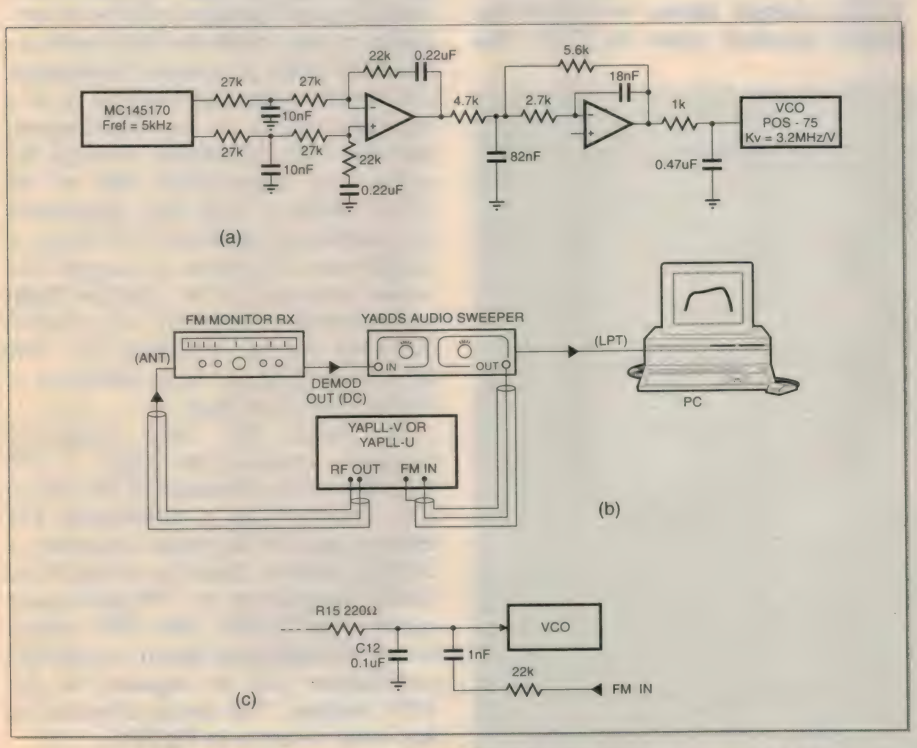


Fig.8: Shows (a) the filter values for a POS-75 VCO and PLL reference of 5kHz; (b) the test setup for measuring the PLL noise reduction response; (c) how to add an FM modulation port to the YAPLL-V module.

$$t3 = R_{15} \times C_{12} = \frac{1}{2\pi \times f_n \times K_M}$$

The biggest practical MKT capacitor for C12 is 0.47uF, thus R15 = 1.129k, or the nearest higher standard value of 1.2k.

The corner frequency of the RC time constant R14/C11 has to be KM times less than the loop natural frequency:

$$t2 = R_{14} \times C_{11} = \frac{K_M}{2\pi \times f_n}$$

Again selecting C11 as high as practical, say 0.22uF, R14 calculates out at 22k. The values of R13 and C10 follow the values of R14 and C11 (22k and 0.22uF, respectively).

Now, we can either do some more maths and set the loop gain to unity at the desired loop natural frequency (wow!) by calculating the required values for resistors R9 to R12 — or we could fit two trimpots instead of R9-R11 and R10-R12 and adjust them for best transient or frequency response (using the 'hop' command of the drivers). Once the correct value is found, halving it gives the values of R9, R10, R11 and R12.

To calculate the required value of the series equivalent of R9-R11 and R10-R12, use:

$$R_{eq} = R_9 + R_{11} = \frac{Kv \times K_P \times K_M}{N \times (2\pi f_n)^2 \times C_{11}}$$

where N is the main divisor value for the design frequency, Kv is the VCO gain in MHz/V, and Kp is the phase comparator output voltage for 2π radians phase error, in volts (usually the Vcc of the device). In our example, dimensioning the loop for operation at a mid-band frequency of 50MHz, using a POS-75 with a tuning voltage slope of 3.2MHz/V, and assuming our selected loop natural frequency of 100Hz, Req can be calculated as:

$$R_{eq} = \frac{(3.2\,MHz/V) \times (5V) \times (3)}{10000 \times (2\pi 100Hz)^2 \times 220nF} = 55.3K\Omega$$

or,

$$R_9 = R_{10} = R_{11} = R_{12} = 27K$$

Capacitor C9 is set for a corner frequency of 10 times the loop natural frequency, where the equivalent resistor, Rp, is the parallel connection of R10 and R12:

$$t4 = R_p \times C_9 = \frac{1}{2\pi \times f_n \times 10}$$

As R9, R10, R11 and R12 are all 27k, C8 and C9 are now calculated as:

$$C_8 = C_9 = \frac{4}{2\pi \times R_{eq} \times f_n \times 10} = 11.5nF$$

or the nearest smaller value, 10nF.

Calculating the loop filter values for the UHF version of the modules is similar, but there is a slight difference: C11 can not be selected arbitrarily (recall that in the example above, we picked the largest practical value for C11). The equation for selecting C11 is:

$$C_{11} = \frac{Kv \times K_P \times K_M}{N \times (2\pi f_n)^2}$$

where Kp in this case is the maximum charge pump current of the PLL IC for 2π radians phase error.

After C11 has been determined, R14 can be calculated as described previously, from the time constant t2. Time constant t4 is now determined only by the C8/R13 RC combination, not the parallel equivalent of the two resistors as before — because the output impedance of the PLL IC, being a current source, is very high.

The active lowpass filter built around U3A is best set for a corner frequency of around 10 times the loop natural frequency, with 'maximally flat' (Q = 0.707) usually a good choice. The corner frequency of the filter for the component values shown is 20kHz; thus to obtain a corner frequency of 1kHz we need to scale the values of RC in the filter by a factor of 20. Say, increase the C values by 4.25, and the R values by 4.7: R18 = 4.7k, R19 = 2.7k, R20 = 5.6k, C16 = 18nF and C15 = 82nF.

The final circuit diagram for the loop filter for this example is shown in Fig.8(a).

Using the YADDS Audio Sweeper is an excellent tool for quickly diagnosing the performance of phase locked loops. If a frequency modulation signal is injected into the loop, the resulting closed loop frequency response (denoted en(f) in the literature) will be an indication of how much the loop supresses the VCO noise at various frequencies. The resultant transfer function is of a high-pass type — at very low frequencies the loop completely corrects the errors (say temperature drift of the VCO), while at very high frequencies the modulation signal (or VCO noise) is passed on to the output unchanged. The corner frequency of the resultant high-pass response is generally very close to the loop natural frequency, fn. The amount of 'peaking' is an indication of the stability of the loop.

To obtain the loop frequency response, connect the input of the YADDS Audio Sweeper to the output (DC coupled!) of a monitoring FM receiver tuned to the output frequency of the PLL module. Inject the output of the Audio Sweeper as an FM modulating signal to the YAPLL (the UHF version has an FM input port, but an external RC combination will be required for the VHF module). The circuit diagram for this setup is shown in Fig.8(b).

Fig.9 shows the resultant frequency response, for a YAPLL-V module configured as detailed in the above exam-

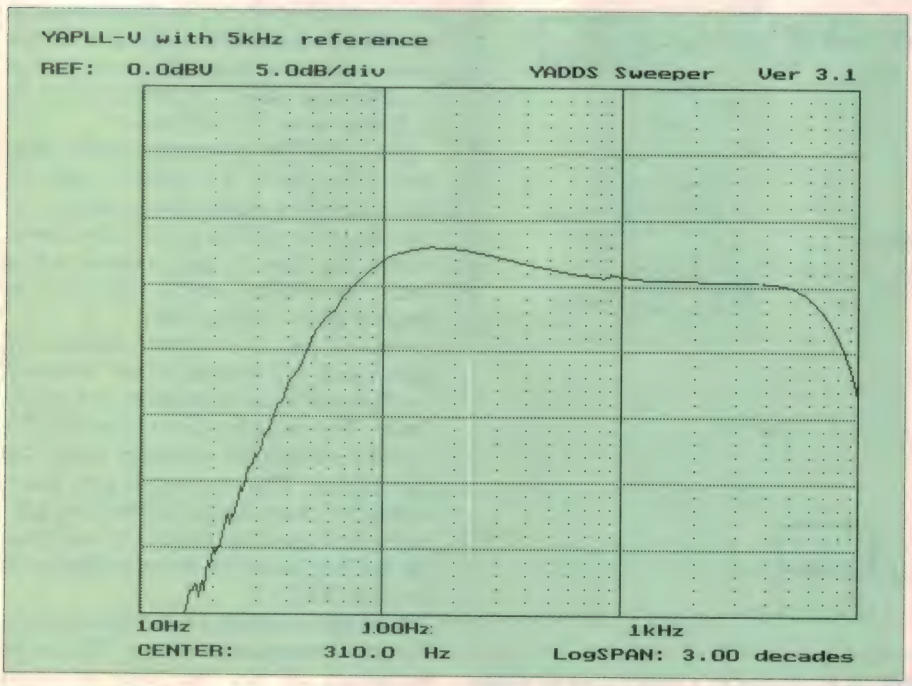


Fig.9: The loop frequency response for a YAPLL-V module configured as shown in Fig.8(a).

ple. From the curve, it can be seen that the loop natural frequency is indeed very close to 100Hz (as designed) and that the peaking is a moderate 2.5dB. The rolloff above 5kHz is due to the narrowband monitoring FM receiver — the YAPLL itself will give a flat response up to at least 100kHz. To monitor the frequency response accurately, a wideband FM monitor receiver is required.

A small complication here is that the same PC is required to drive the Audio Sweeper and the YAPLL under test as well. But, once the desired frequency of the PLL module is set, the DB25 cable can be disconnected from it and connected to the Audio Sweeper. A printer switchbox would come in very handy for cases like this.

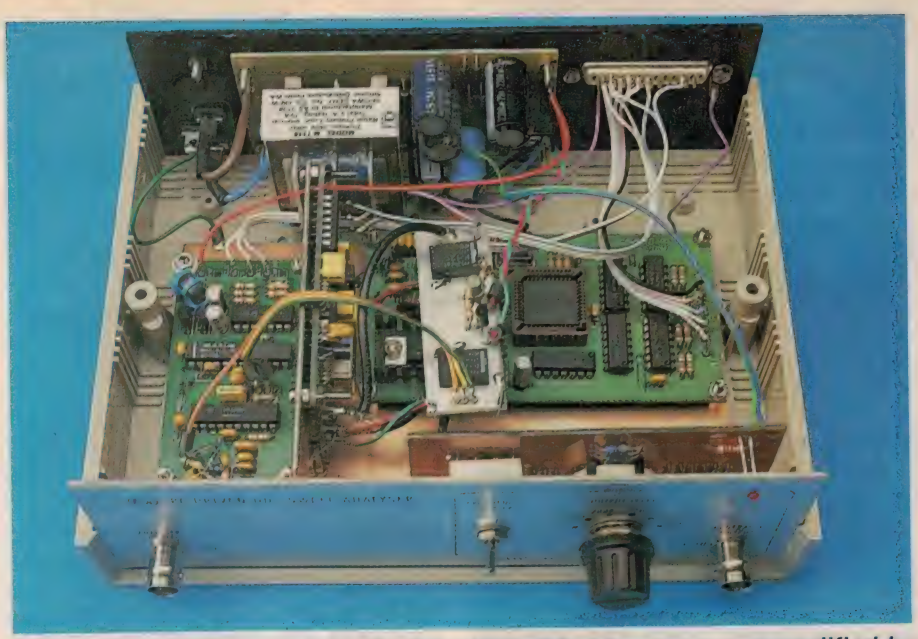
DDS controlled PLL

If the prospect of calculating and verifying the loop filter components for each application sounds terrifying, the good news is that if the YAPLL modules are controlled by a YADDS-1 as an external frequency reference, as shown on the block diagram of Fig.3(b) last month, there is no need to change anything in the loop filter values from their default setting.

The reason for this is that in this configuration the frequency step is not determined by the PLL reference — thus it can be fixed to any convenient value. The loop filter components shown in Figs.1 and 4 have in fact been selected to allow any POS-xxx VCO block to be used in the VHF and UHF versions of the YAPLL modules. The nominal PLL reference frequency is 200kHz for the VHF version and 100kHz for the UHF.

To enable the PLL modules to be controlled by a DDS source, X1 is replaced by a 10.7MHz ceramic filter and components C5, C6, CT1 and R7 removed. The clean output signal of the PLL module will now be enhanced by the fine frequency resolution provided by the DDS module. The drivers, 'YAPLLV.EXE' and 'YAPLLU.EXE' are preconfigured for this setup.

The following example shows how the required PLL 'N' and 'R' divisors, and the required DDS output frequency are determined. Let us assume that we want to generate a 145.725MHz output signal in the 2m amateur band (for this, we will need a YAPLL-V module with the POS-150 VCO module fitted). Assume for a moment too that the PLL module is set to operate with a reference frequency of 100kHz, obtained by dividing down the frequency of a hypothetical 10.7MHz crystal by R = 107.



Just to whet your appetite: a look inside a PC-driven sweeper modified by the addition of a YAPLL-V module, to extend its operation up to VHF. More details in the third article...

To obtain the desired output frequency, the required PLL 'N' divisor would need to be 145.725MHz/0.1MHz = 1457.25! Of course this is impossible, because 'N' has to be an integer. Thus, as usual in PLL systems, we have to settle for the nearest multiple of the reference frequency, which is 145.700MHz in this case.

It would be possible to obtain the exact desired output frequency by pulling the reference crystal 'off' frequency — indeed, some commercial transceivers use this technique to obtain the 100Hz frequency steps. In our case, to obtain the required PLL reference of 145.725/1457 = 100.01716kHz, the crystal would need to be pulled to 100.01716kHz*107 = 10.701836MHz.

Instead of wondering how to pull the frequency of a crystal exactly, why not use a DDS module — generating 'odd' output frequencies is just what DDS modules are good for. Just program up a YADDS module for the required frequency, feed the output into the YAPLL instead of the on-board crystal oscilator, and the problem is solved!

The sample driver programs, YAPLLV.C and YAPLLU.C, controlling both the YAPLL modules and the YADDS-1 board simultaneously, use the method described above to achieve fine frequency resolution output from the PLL modules. The required 'N' and 'R' divisors are programmed into the PLL modules, and then the YADDS-1 is programmed to supply the correct crystal reference 'substitute'.

The YADDS Sweeper software, starting from version 3.1, has provision to drive a DDS driven PLL module as well, using the same method I've just described above. If the setup file specifies:

do_PLL=1

the output frequency is assumed to be generated by a PLL module, which in turn is controlled by a YADDS-1.

By default, a VHF module is assumed. To drive a UHF module, specify:

PLL_U_type=1

in the setup file. For more details, see the 'Sweeper.doc' file that comes with the latest versions of the YADDS Sweeper.

A more complicated version to control the N, R and DDS frequency would keep the loop gain of the PLL constant, by changing the R as well. However I'll leave this exercise to the more adventurous readers...

Module assembly

Before assembling the PLL modules, first clarify all the available options to avoid unsoldering components later. In particular, decide whether the standard loop filter will be used or the loop filter will need changing. Also, decide whether the additional active lowpass filter is going to be used or not — on the VHF module, mounting R15 upright along the dotted lines disables the filter, while on the UHF module fitting R31 instead of R32 does the same.

The default supply voltage is +18V and -5V, but if a single supply of +15 - 16V is used, U3 can be changed to a CMOS, rail-to-rail output type and the -5V line connected to ground.

Finally, determine whether the on-board crystal will be used as a reference or a

PLL 'Building Block' Module — 2

YADDS-1 module will be supplying it externally. In the latter case, do not fit C5, C6, CT1 and R7, and replace the crystal with a 10.7MHz ceramic filter. Keep in mind that desoldering components from a board with plated-through holes is more difficult than from the usual 'amateur quality' single-sided PCB's.

To assemble the boards, start with all the passive components and semiconductors, leaving the VCO module for the end. D1 is soldered on the bottom side of the board, straight across the pins of the VCO module.

When the board is completed apply power, and check that the VCO module supply voltage is between 12V and 15V — adjusting R2 if required (15V will give slightly more RF output level). Then run the driver program, and check that the crystal oscillator is working (or that the YADDS-1 generated reference is available) by looking at the RefOut pin of U1 with a CRO. Monitor the output frequency with a frequency counter, and simultaneously measure the VCO control voltage. In the 'locked' condition, the control voltage will follow the 'f' frequency commands.

If the DDS-driven PLL setup is used, the driver is preconfigured to start generating the desired output frequency immediately. Otherwise, specify the actual crystal frequency and the desired R divisor, and also make sure that the C register is programmed for the correct value.

If the output frequency does not change, first check that the correct printer port is specified in the software (278H is preconfigured — anything else will need recompiling). If the correct port is used, the activity on the clock, data and enable lines should be visible on a CRO.

Next, check that the correct phase comparator polarity is specified (default: active loop filter, PD_TRUE). If the VCO control voltage is stuck low (-0.7V), try specifying a target frequency below the actual output frequency — if the control volts now jump high, this is a sure sign that the polarity needs inverting. Polarity is the MSB of the control bit, type 'C00' if the optional active filter is in use, 'C80' if not ('C40' or 'CC0' for the UHF module).

On the UHF module, the MC145191 IC is soldered on the bottom side of the PCB, as usual for surface-mount devices. The suggested procedure is the following: lightly tin one pad and solder the IC at one pin. Once the correct positioning and orientation is achieved, the rest of the pads can be soldered too. Make sure the IC is orientated properly; the correct orientation is when pin 1 is facing the crystal or ceramic filter.

In the next article, I'll describe how the YAPLL modules can be used to extend the frequency range of the RF Sweeper project of September/October 1995, into the VHF region.

Further reading

Meantime, for those who would like to do some more reading about phase-lock loop design for RF applications, here are some useful references:

1. Motorola MC145170 and MC145191 Data Sheets.
2. Motorola application note AR254 #1, #2, #3 and #4 — Communications Device Data Book.
3. Gardner, F.M., *Phaselock Techniques.* John Wiley & Sons, Inc., New York 1966.
4. Gardner, F.M., 'Charge-pump Phase-lock Loops', in *IEEE Trans. Commun.*, Vol COM-28 No 11, November 1980.
5. Philips Semiconductors, UMA1014 Data Sheet.
6. National Semiconductors, LMX1501 Data Sheet.
7. Jim Rowe, 'A PC Controlled Sweep Analyser', in *EA* Sept/Oct. 1995.

(To be continued.) ❖

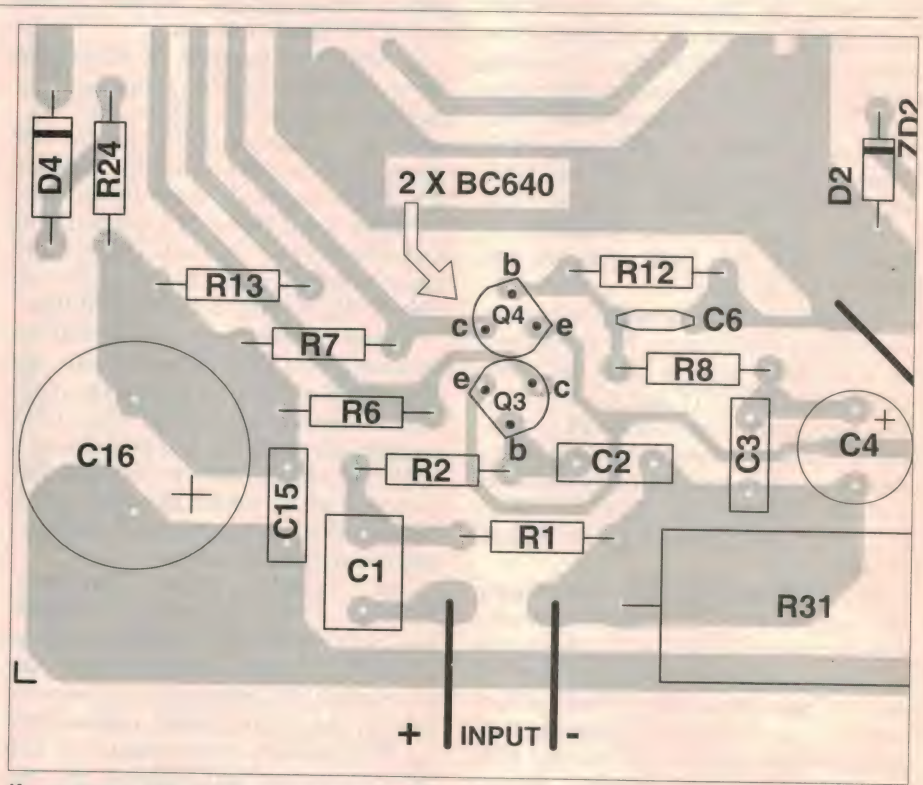
NOTES & ERRATA

Low Cost RF Test Oscillator (May/June 1996): Dual op-amp U12 was omitted from the parts list in the May article, but was identified correctly in both the schematic of Fig.3 and the PCB overlay diagram of Fig.5 as either a TL072 or LF353.

PC Bus Sleuth (October 1996): If the main PCB is shorter than the correct width of 5.25 - 5.30" (13.3 - 13.5mm), the card can become misaligned in the ISA slot. This creates the possibility of adjacent contacts in the ISA socket being shorted together by the misaligned contact pads on the PCB, causing damage to the motherboard.

As mentioned in the testing section of the original article, you should always check that these contact pads correctly line up in the ISA slot before switching on the computer.

Pro Series 3 Amplifier (February and March 1994): Some stocks of BC556 transistors cannot quite cope with the voltage placed across them in the input differential stage (Q3 and Q4), and suffer from (non-destructive) voltage breakdown. This in turn causes an intermittent hum or buzz through the speakers, or in extreme cases, 'motorboating' at the output — a fairly loud series of pops through the speakers.



If you suspect that this may be the case, replace the two BC556 transistors (Q3 and Q4) with BC640 types as shown in the associated diagram. Note that the 640's have a different 'pin out' to the 556's, and you will need to install them exactly as shown in the diagram — despite their rather odd angle. The BC640's will be difficult to thermally couple when installed as shown, however this has a minimal (that is, inaudible) effect on the amp's performance. ❖

Assemble your own

HIGH QUALITY 'JC30' COMPACT SPEAKER SYSTEM

At an all-up kit price of just $349/pair, these new two-way kit speakers from Jaycar may well represent about the best value-for-money around in high-performance bookshelf loudspeakers. They use a robust 150mm bass driver plus a 19mm Vifa tweeter in a very solid little 12.7 litre vented enclosure, which is supplied in an 'undressed' form.

by ROB EVANS

Jaycar Electronics has been strong in the area of kit speakers for many years now, and seems particularly adept at offering home constructors do-it-yourself systems that perform well, but only cost a fraction of equivalent commercial speakers. But as those readers interested in loudspeaker design are no doubt aware, this favourable balance between price and performance is not easy to achieve, and in the current economic climate could even be regarded as the *true* art of speaker design...

In the case of the new JC30s, this task was taken up by Jaycar's in-house speaker wizard Phil Routley, who reportedly spent a considerable amount of development time in extracting the best possible performance from the JC30s driver/enclosure combination. The end result is a compact low-cost speaker system that doesn't use exotic (and expensive) drivers — but as we found during testing, offers a level of performance that's far beyond what you'd expect from the purchase price.

Of course we should point out here that a significant part of the cost saving in the JC30 kit can be attributed to the 'undressed' or unfinished nature of the enclosures. This in turn means that you need to put a little more effort into the kit construction than is the case with the more common 'screw in the components and away you go' type of speaker kit.

More specifically, the JC30 enclosures are constructed from 19mm 'MDF' board which is covered in an unfinished real-wood veneer, and this needs to be stained and/or lacquered to bring the cabinets up to an acceptable appearance level. Also, a set of speaker grilles need to be built from the supplied grill cloth and hardwood beading, plus the enclosure's vent hole must be enlarged to accommodate the plastic port tube supplied.

These jobs should not pose much of a problem to those with a modest level of woodworking skills, and the fundamental quality of the enclosures should make the effort worthwhile. You not only end up with an attractive and very solid set of cabinets, but save a considerable amount of money in the process. The boxes measure 215 x 280 x 335mm and you have a choice of Jarrah or Blackwood veneer, by the way.

The JC30s bass frequencies are handled by one of Jaycar's own 150mm (6") woofers (catalog number CS-2240), which features a carbon fibre cone material, an extremely large magnet assembly and a reported power rating of 80W RMS. The driver is a four-ohm unit, and this sets the nominal impedance of the JC30s at that figure.

The upper end of the audio spectrum is delivered by the well-known Vifa D19 dome tweeter, which has been around for a considerable number of years and is a creditable performer in its own right. Just for the record, the D19 features a lightweight 19mm polymer diaphragm coupled to a ferrofluid damped voice coil, and has a fairly smooth response which extends out to around 20kHz.

As shown in the associated schematic, the JC30s crossover is of the second-order type and as a result features nominal roll-off slopes of 12dB per octave for each driver. The crossover point is set to around 3kHz with the 0.39mH inductor and 10uF acting as a low-pass filter for the bass driver, and the 4.7uF cap and 0.36mH coil forming a high-pass filter for the tweeter.

Other than that, the 5.6 ohm resistor and 15uF capacitor wired across the woofer compensate for the rising impedance (with frequency) of its voice coil, and the 'L-pad' formed by the 2.2 ohm and 12 ohm resistors provide a small degree of attenuation for the tweeter.

As you can also see in the schematic, signals are passed to the tweeter and its filter via a series 'trap' circuit based on a 4.7 ohm resistor, a 0.05mH inductor and a 2.2uF capacitor — all connected in parallel. At its 'tuned' frequency the series impedance rises to around 4.7 ohms (as determined by the resistor),

which in turn reduces the drive supplied to the tweeter at that frequency. This has been set to around 14kHz and for a dip of about 6dB, so as to compensate for a natural peak in the D19's high-frequency response in this design.

On test

We performed our usual array of checks on the JC30s, with the objective testing primarily handled by our IMP testing system and our subjective impressions gained by a series of listening tests in a home environment. All in all the JC30s acquitted themselves very well, and as mentioned earlier, delivered a performance that could be expected from a much more expensive bookshelf speaker system.

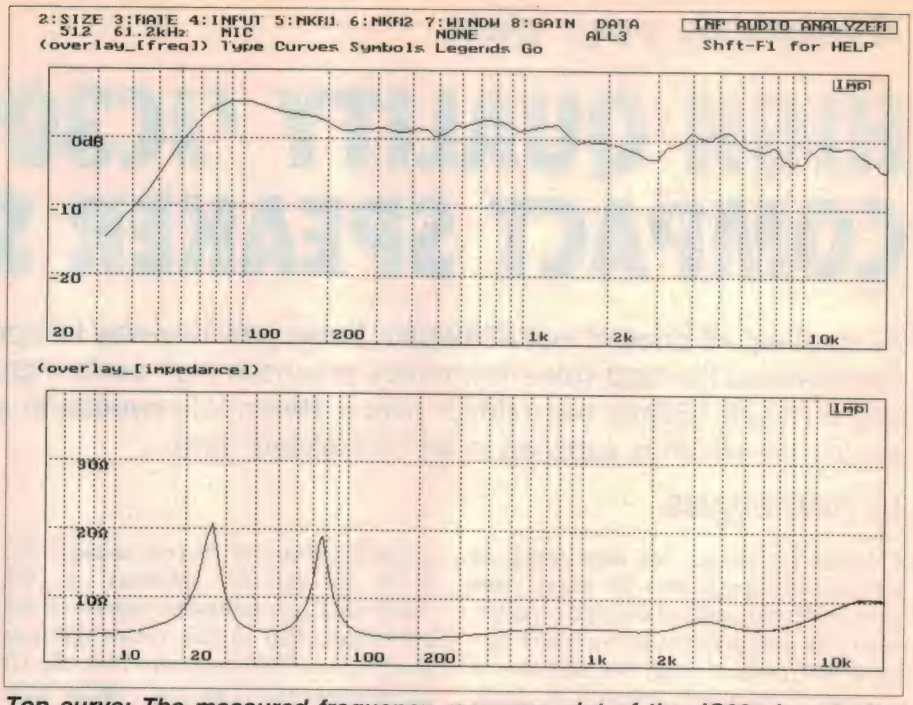
As you can see from the published impedance curve, the JC30s have a minimum impedance of around four ohms as expected. The curve shows the usual double-hump at the low end that is a characteristic of vented enclosures, and otherwise makes no other significant deviations that may upset fussy amplifiers. Note that the dip between the two low-end peaks indicates a box tuning frequency of around 45Hz.

The fact that the JC30s are nominally a four-ohm system means that you will need to check that your amplifier can handle the higher output currents demanded by this type of load. This should not be a problem for almost all recently-produced amps, and may in fact be an advantage in some circumstances, since the available power is much higher — most amps will deliver around double their eight-ohm rated power into a four-ohm load.

Turning to the measured frequency response curve, you can see that the JC30s show only modest deviations over the normal audio band, with a small but broad peak showing at round 100Hz. This slightly over-zealous bottom end turned out to be due to the box position during that test, as the rear-mounted port tends to be effected by nearby walls.

Further tests indicated that this proximity effect can — within limits — be used to advantage by positioning the speakers to suit your own listening tastes. The slightly peaky bass response shown in the plot may suit those who primarily listen to contemporary and popular music, while others may prefer to position the JC30s for a less augmented bottom end.

The only other significant point to note here is that the response curve only has one-sixth octave smoothing applied rather than the usual one-third octave, and as a result is not necessarily shown in the best light when compared with other response plots. For the testing of these speakers, we found that the less severe smoothing algorithm was far more revealing.

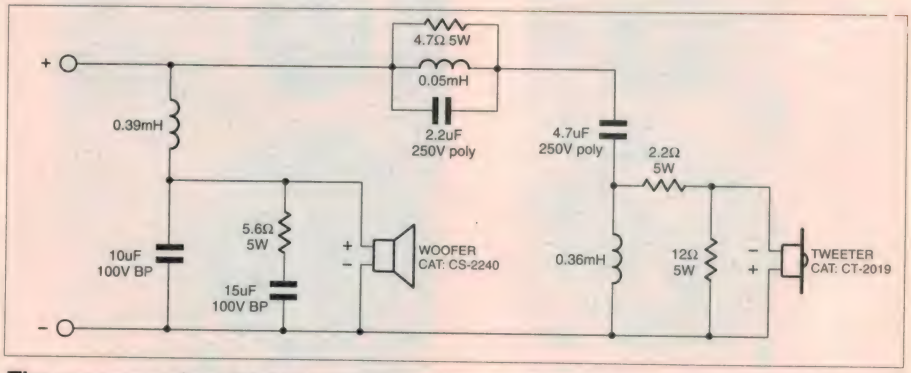


Top curve: The measured frequency response plot of the JC30s in a typical domestic environment; with one-sixth octave smoothing applied. Above curve: The JC30s impedance variation over the full audio range. Below: The enclosure's rear panel with the terminal plate and flanged vent tube installed.

While our listening tests were over a shorter period than we would normally prefer — there's only so long the surrounding family will stand this type of intense auditioning! — the JC30s again turned in an strong performance.

We were most impressed with the general balance and smoothness of sound, and in particular, with the system's transient response during more demanding tracks. This latter asset is not uncommon in systems based on small and relatively powerful bass drivers, as the combination of a strong electro-magnetic motor and a relatively lightweight cone assembly leads to a 'fast' driver response.

Other than that, the JC30s gave the



The crossover is a fairly conventional second-order arrangement, with a number of additional elements included to 'tune' the response of both drivers.

impression that you were listening to a much larger set of speakers — depending upon their positioning in the room, of course. This is mainly thanks to the quite extended bottom end response of the system, which could only be improved to a small degree by the addition of a compact subwoofer.

The JC30s are significantly larger (and certainly heavier) than what is regarded as a standard 'bookshelf' speaker system however, so the extended low-end response does come with a slight penalty of additional bulk. Just how they are most easily fitted into an existing stereo setup will depend upon individual circumstances of course, but you will need a quite large bookshelf for *that* particular installation method.

With a nominal power rating of 80W, a surprisingly wide bandwidth and quite smooth response, the JC30s should suit those who want a small speaker system with lots of 'punch'. As long as you don't mind putting in the extra work to bring the cabinets up to scratch, you'll end up with a very nice little set of speakers for a minimal outlay. Considering their total kit price of just $349/pair, they seem to represent excellent value for money.

Jaycar are also selling the JC30 enclosures and drivers as separate items by the way. The cabinet kit includes all of the items needed to complete the enclosures (rear terminal plates, port tubes, innerbond filling, and so on), and is priced at $169 for a pair — so if you already have a suitable set of drivers, this may well be worth considering.

The driver kit includes all of the drivers plus crossovers for the system, and is available for $229. As you may have noticed, purchasing the driver and cabinet kits as separate items will cost you a total of $398, so Jaycar's offer of a complete kit at $349 appears very attractive indeed.

Needless to say, you can check out the JC30s for yourself at your nearest Jaycar Electronics store. And by the way, Jaycar tells us that they have fewer Blackwood-veneered cabinets than those finished in Jarrah, so get in early if that is your preference. ❖

The boxes in their 'raw' form, as supplied with the kit. The completed grill assembly fits over the chamfered edge of the front baffle — ignore how the hardwood beading has been used on our completed enclosures.

Gates & Grove...

Continued from page 37

Gates foresees that the latest upgrades to the operating and application software will be downloaded automatically when a user connects to his firm's corporate network. Similarly, CD-ROM software will not need to be 'installed' and take up space on the hard disk drive. Instead, the user will be able to work from the CD-ROM exclusively and only store data files created with the application on his hard drive.

All of these and other developments will take place in a rapid tempo, Gates said, because the economies of scale in the PC market enable companies to quickly move even the most technologically advanced products to market quickly with minimal mark-up and still achieve substantial profits.

"The end goal comes back to the vision of information at your fingertips. The PC is the ultimate empowering tool. And although first we'll see how that is used in business, we'll see it in our homes and in our schools and in our libraries."

Gates concluded by saying that he is very envious of children today, who will be growing up with advanced new information tools and will not have to go through what our generation had to experience. "These kids will look at our PCs and say; 'Hey, these were the machines that couldn't listen, couldn't talk, and couldn't see'..." ❖

FEBRUARY PRE CATALOGUE SALE

NEW JC 30 COMPACT SPEAKER KIT

REFER EA FEB. 97

Crossovers shown are representative only

This speaker kit came about because we purchased a quantity of high quality cabinets from a woodwork factory who had made them for a speaker manufacturer who went broke. We purchased the cabinets at a fraction of their build cost and designed the speaker kit around them. The cabinets are extremely high quality. They are made from 19mm MDF board which is covered in an unfinished real wood veneer and needs to be stained and/or lacquered. There is a small amount of construction work required to complete the cabinets and this is reflected in the low price of the kit. Specifically this work is: rear port hole needs to be slightly enlarged, speaker grills need to be built from 4 pieces of pre cut hardwood beading supplied and grill cloth needs mounting. These jobs should not pose much of a problem to those with a modest level of woodworking skills. The fundamental quality of the enclosures will make the effort worthwhile. There are two choices of cabinet wood finishes available - Jarrah (dark) and Blackwood (light). We have a much larger quantity of Jarrah finish available. We reserve the right to to supply Jarrah when the Blackwood stocks are exhausted. THE SPEAKER KIT - the woofer used are our Re/Sponse Carbon Fibre Drivers and the tweeters are Vifa D19. The crossovers are pre built. The total impedence is 4Ω, which is not a problem for most amplifiers and they could even be used in a car stereo system. Power handling is 80WRMS.

SPEAKER KIT

Includes: •2 x 6" carbon fibre woofers •2 x Vifa D19 dome tweeters •2 x pre built crossover networks.

Cat. CS-2590 **$229 Pr**

CABINETS

Includes: •2 x pre built cabinets •Grill frame pieces •Speaker cloth •Rear terminals •Innerbond •Ports •Speaker grill clips •Wire.

Jarrah Cat. CS-2592
Blackwood Cat. CS-2594 **$169 Pr**

Normally $398 Pr

BUY SPEAKER KIT AND CABINET KIT TOGETHER

Pay Only $349 Pair

Quote from Rob Evans - Electronics Australia

At an all up kit price of just $349 a pair, these new two-way kit speakers from Jaycar may well represent about the best value-for-money around in high performance bookshelf loudspeakers.

FRIDGE MAGNETS NEW

A packet of 100 small magnets that can be used for fridges, memos, holders or simply to teach children about magnetism. 000's of potential uses. 13(W) x 9(L) x 4(D)mm. Craftworkers! This magnet is ideal as the magnetic component for your fridge mounted novalty or message. Ask us for a quantity quote!! Cat. TH-1876

Pkt of 100 $4.95

25 MHZ CRO

See 96 Cat, P33 Limited qty available.

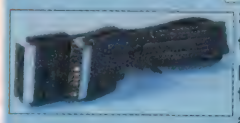
Cat. QC-1900
Was $749
Save $100
February $649
Includes two probes.

DIGITAL CAPACITANCE METER

0.1pf to 20,000uf.

Cat. QM-1572
Was $99.50
Feb $79.50
Save $20.00

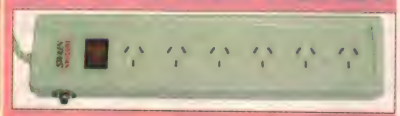
SCART LEAD



Scart plug to scart plug. Used to sell for around $25

Cat. AV-6550 **Only $5 ea**

6 WAY POWER OUTLET WITH MAINS FILTER



Not only is it a 6 way power board, it incorporates a voltage surge and spike protector and noise rejection filter network. Supplied with two metre cord and mains plug, safety shutters on each outlet, illuminated master on/off and even a safety circuit breaker. Cat. MS-4030

Was $43.95 Save $14.00

Now $29.95

NEW CATALOGUE NEXT MONTH

STORAGE SYSTEMS

TOOLCASE NEW

Quality ZAG brand, made in Israel. Amazing 6 year warranty! Its built to last. It has a tote tray inside, which is a tray with a handle to store tools like screwdrivers etc. It simply lifts out to reveal one large compartment which is the full size of the toolbox. Total size 405(L) x 205(D)x180(H)mm. Tool compartment size 375(L)x175(D) x100(H)mm. It is lock-able & has a tongue & groove lid system, which helps to keep water out. The box is so strong, you can sit on it to eat your lunch. A top quality low cost tool box. The unit it replaces sold for $39.95!!!

Cat. HB-6334 **$19.95**

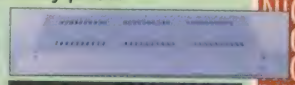
PACK 'N' LATCH CABINET NEW

Pack 'N' latch is a quality ZAG product, made in Israel. It has a 6 year warranty. It is the best plastic parts cabinet we have ever seen!! It is ideal for tran-sporting parts and can be attached to a wall. Each draw latches, so there is no chance of the drawers falling out, spilling the parts. There is 6 drawers, 4 x 38mm(H) and 2 x 58mm(H). The small drawers have 3 large compartments, which with the dividers supplied can become up tp 10 smaller compartments or any combination. The large drawers are one compartment, but can be made up to 5 smaller compartments, or any combination. There is a handle for carrying and screws and rawl plugs for wall mounting. Total size is 345(H) x 305(W) x 145(D)mm.

Cat. HB-6322 **$39.95**

44MM SILVER RACK BOX

Grab one for a spare at this crazy price. Includes front panel.



Cat. HB-5411 **was $69.95**

FEB $39.95 Save $30

TWIN ORGANISER

Quality ZAG brand, made in Israel. Amazing 6 year warranty! This product is a double sided tool/parts storage system. It has a carry handle so it can be carried like a briefcase. Each side is the same & has 18 separate compartments. All compartments have the same depth - 50mm and length 65mm, only the width changes - and there is 13 x 55mm wide, 4 x 85mm wide and 1 x 290mm wide. As its double sided, all the above numbers should be doubled - ie - 36 separate compartments in total. When the lid is closed, parts will not jump from one compartment to another. The lids are clear, so you can see what you are after without opening the lid. Total size is 350(L) x 280(H) x 130(D)mm. A top quality parts storage system.

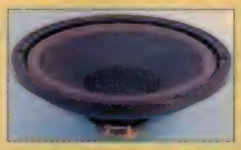
Cat. HB-6346 **$29.95**

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

UNBELIEVABLE SURPLUS SPEAKER DEALS

We have made a massive purchase of some discontinued speakers from Etone. The speakers are NOVIK brand and are made in Brazil. NOVIK have been around for some time, we even used to sell them some years ago. Ideal replacement speakers. Save up to 50%. Limited quantities.

12" WOOFER



Power handling 40WRMS Frequency response 30Hz - 3.5kHz. Paper cone, plastic front surround. Speaker weight 1.6Kg.

Cat. CW-2124 **Only $29.95ea**

10" WOOFER

Power handling 40WRMS Frequency response 35Hz - 4.0Khz. Paper cone, plastic front surround. Speaker weight 1286gr.

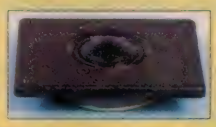
Cat. CW-2120 **Only $24.95ea**

5" MIDRANGE

Power handling 120WRMS system power. Suggested crossover points - 800Hz and 5Khz. Clear poly-propylene cone. Speaker weight 590gr.

Cat. CM-2070 **$14.95**

DOME MIDRANGE



Power handling 150WRMS system power. Suggested crossover points 500Hz & top crossover point between 5Khz and 12Khz. Speaker weight 810g. Size 130W x 114Hmm front. Cutout about 90mm dia. 1.5" (38mm) dome. **Cat. CM-2074** **$24.95**

6" 8Ω TWINCONE

Ideal low cost replacement speaker. Has a twincone and cardboard cone. power handling is around 6watts. Diagonal mounting holes 155mm. Weight 353gr.

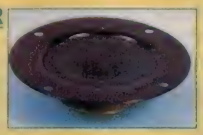
Cat. AS-3013 **$7.95**

8" TWINCONE PA SPEAKER

This twincone 8" speaker is ideal for PA. It is very similar to our CE-2325 model, except that it does not have mounting holes for a line transformer. Power handling is 10WRMS. Frequency response is about 100Hz to 17,000HZ. Weight 430gr.

Cat. CE-2326 **$12.95**

ROUND CONE TWEETER



Power handling - about 50WRMS system. Frequency range 2K - 16Khz. Suggested crossover point is about 3Khz. Overall diameter 85mm. Cutout size - min.55mm. Weight 108gr.

Cat. CT-2001 **$9.95**

SQUARE CONE TWEETER

Power handling - about 50WRMS system. Frequency range 2K - 16Khz. Suggested x'over point is about 3Khz. Size - 57 x 57mm. Cutout size 55mm. Weight 93gr.

Cat. CT-2002 **$7.95**

PIEZO TWEETER

Power handling 120WRMS, no crossover required. Front panel size 135(W) x 65(H)mm.

Cat. CT-1915 **$8.95**

8MM CAMCORDER CLEANING KIT

Keep your video camera in top shape! Kit includes: •Head cleaning tape •Bottle head cleaning fluid •Bottle lens cleaning fluid •Blower brush •50 sheets lens cleaning tissue paper.

Cat. AR-1420

Retail Price Was $24.95
Were selling For $12.95
February Sale only $7.95

CD STORAGE CASES

Priced way below normal. With black opening doors. Very limited quantities.

60 CD's	36 CD's
Retail $59.95	Retail $39.95
February Sale $25	February Sale $15
Cat. AR-1482	Cat. AR-1481

ROBO LIGHT

PIR controlled portable light. Buy one for your parents. Simply position on the floor, or on a table and when they walk near it at night, it will come on for them to see. Also ideal for verandahs, loos, toolsheds, etc, etc. Works on 4 x C batteries and has a 6VDC socket, so you could use it with a 240V plug pack. We have bought a quantity at a very good price. See 1993 cat where it was $34.95 **Cat. LA-5008**

February Sale $12.95 **Save $22**

ELECTRICIANS PLIERS

Quality big pliers (length 230mm)

Cat. TH-1895 **Wholesale Price is $35**

Was $25.00 **February Sale $12**

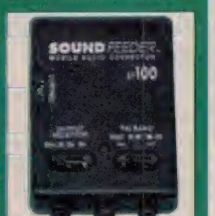
100 WATT SPEAKER FADERS

Control the volume of extension speakers. Supplied with plastic face plates. 50WRMS handling.

MONO
Cat. AC-1672
Was $19.95
Save $7.00
February Sale $12.95

STEREO **Cat. AC-1673**
Was $31.95 **Save $10.00**
February Sale $21.95

CD / AUX TO CAR FM SOUND FEEDER



Use your portable CD players, or walkman in your car. Also powers the player from the cars power.

See 96 Cat, page 68. **Cat. AR-1750**

Was $47.95 **Save $10**
February Sale $37.95

INNER EAR HEADPHONES

Supplied with set of spare ear pads. Frequency range 20Hz - 20kHz.

Cat. AA-2014
Was $3.95 **Save $1.95**
February Sale $2.50

HIGH QUALITY HEADPHONES

If you want something better than the low cost ones above. See 96 Cat page 57.

Cat. AA-2015
Was $8.50 **Save $3**
February Sale $5.50

27MM (1.1") MYLAR SPEAKER

8 ohm, 0.25 watt. **Cat. AS-3002**

Was $2.60

February Sale

1-9	$1.50
10-99	$1.20
100+	$0.80

UNDIRECTIONAL DYNAMIC MIC

Complete with on/off switch, cable to 6.5mm plug. 600Ω imped, 80 - 12,000Hz frequency. **Cat. AM-4090** **Was $9.95**

February Sale $6.95

30 METRE ROLL OF SIX CORE ALARM CABLE

Cat. WB-1593
Cat Price $27.95
Feb $13.95 **1/2 PRICE**

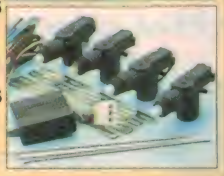
JAYCAR WHOLESALE (02) 9743-5222

CAR ALARM DEALS - AMERICAN LEGEND / EQUATOR

American Legend Car Alarm

Features learning remotes: See Nov/Dec Advertisements.

Deal 1: Buy the alarm at $139.50 and pay only $10 extra for the siren. (LA-8908)
Total $149.50 Save $15.95

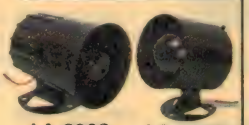


Deal 2: Buy the alarm at $139.50 and pay only $30 extra for the battery back up siren.
Total $169.50 Save $29.95

Deal 3: Buy the alarm and battery back up siren and 4 door central door locking for only **$249** and save **$39.50.**

ALARM	$139.50	LA-8912
SIREN	$60.00	LA-8910
LOCKING	$89.00	LR-8830

Normally **$288.50**
$249 and save **$39.50**



LA-8908 LA-8910

Equator Car Alarms

See cat for full details

EQUATOR LA-8902

Deal 1: Buy the alarm at $169 and pay only $10 extra for the siren. (Siren LA-8908) **Total $179.00 Save $15.95**

Deal 2: Buy the alarm at $169 and pay only $30 extra for the battery back up siren (Siren LA-8910).
Total $199.00 Save $29.95

Deal 3: Buy the alarm and battery back up siren and 4 door central door locking for $269 and save $48
ALARM: $169.00 SIREN: $60.00 LOCKING: $89.00 **Normally $318**
Total $269 Save $48

EQUATOR LA-8905

Deal 1: Buy the alarm at $229 and pay only $10 extra for the siren. (Siren LA-8908) **Total $239.00 Save $15.95**

Deal 2: Buy the alarm at $229 and pay only $30 extra for the battery back up siren (Siren LA-8910).
Total $259.00 Save $29.95

Deal 3: Buy the alarm and back up battery siren and 4 door central door locking for only $329 and save $49.
ALARM LA-8905: $229 SIREN LA-8910: $60 LOCKING LR-8830: $89
Normally $378 Total $329 Save $49

LA-8908 LA-8910

GUITAR SPEAKER MONTH

Save Big $$$

See 96 catalogue page 49 for full details.

10" 65WRMS SPEAKER
Feb Sale $37.50
Was $57.50 Save $20 Cat. CG-2376

12" 100WRMS
Was $99.50
Feb Sale $69.50
Save $30.00 Cat. CG-2380

15" PROFESSIONAL 200WRMS Was $239
Feb Sale $189
Save $50.00 Cat. CG-2388

SAVE ON WALL BRACKETS

See 96 Cat, page 54 for full details.

Standard Size
Shelf width 300(W)x280(D)mm
Was $34.95
Feb Sale $24.95
Save $10 Cat. CW-2810

Large Size
Shelf width 814(W)x266(D)mm
Was $78.95
Feb $58.95
Save $20 Cat. CW-2815

CAR WINDOW ETCHING KIT

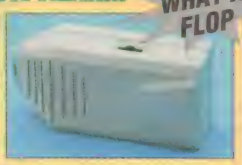
WHAT A FLOP

Etch your vehicle identity number (VIN) on your cars' windows for extra protection. Do it yourself and save a fortune.

Cat. LA-5120 **Was $39.95**
February Only $20
Spare etch cream available for $5.00 Was $9.95 Cat LA-5125

VIBRATION ALARM

WHAT A FLOP



Keep the cat off the lounge! "Tattle Tale" can detect vibration in an object or surface without any apparent motion. Ideal for pet training, security etc.
Made in U.S.A. Cat. LA-5270
Was $39.95 February $20

24 TO 12V REDUCER

Current rating 2.8A. See 96 Cat, page 79 for full details.
Cat. MP-3058 **Cat Price $39.95**
Feb $29.95 Save $10

REMOTE CONTROL SWITCHES

Ideal for garage doors, central door locking, alarms, etc, etc, etc.See 96 Cat P156 for details.

Latching Unit

Both N/O and N/C contacts.
1 receiver and 2 transmitters.
Cat. Price $79.95
Feb Sale $59.95
Save $20 Cat. LR-8824
Spare remote Cat. LR-8825
Was $23.95 **Feb. $16.95** Save $7

Momentary Unit

Both N/O and N/C contacts.
1 receiver & 2 transmitters.
Cat. Price $99.95
Feb $69.95
Save $30 Cat. LR-8826
Spare remote Cat. LR-8827 Was $23.95 **Feb. $16.95** Save $7

0-30V DC 2.5AMP VARIABLE LAB POWER SUPPLY

•Variable output voltage 0 to 30V •Variable current limiting 0 to 2.5A •Fixed 5 and 1.2V output at 500mA •Seperate voltage & current meters. See 96 Cat P34 for full details.Cat. MP-3080 **Was $199.50**
February $159.50 Save $40

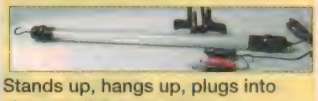
8xAA FAST CHARGER

Charges 2, 4, 6 and 8 AA or AAA at a time, fast. See 96 Cat, page 74 for full details
Cat. MB-3510 **Was $39.95**
February $29.95
Save $10 This Month

12VDC TO 240VAC INVERTER

Power many 240V products from 12VDC car power. See 96 Cat page 75 for full details and specifications.
Cat. MI-5038 **Was $159.50**
February $129.50 Save $30

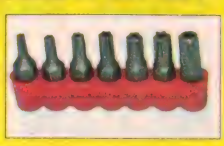
12V 13W FLUORO LAMP



Stands up, hangs up, plugs into cigarette lighter or clips onto battery. Length approx 600mm.
Cat. ST-3020
Cat Price $19.95
February $13.95
Save $6 This Month

TAMPER PROOF TORX SCREW BIT SET

Includes: T10, T15, T20, T25, T30, T40. Made from chrome vanadium steel and heat treated.



Cat. TD-2034 **Was $9.95**
Feb. $5.00

FREECALL FOR PHONE ORDERS
1800 022 888

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888

METEX M3850 COMPUTER CONNECT DIGITAL METER

Features include: •Dual display •R5232 interface •Transistor •Capacitance •Auto hold •Data hold •10 memory •Bargraph •Mix/max display •Relative offset •Logic •20A •4000 count •Backlight •Temperature •40mHz frequency •Auto/manual range. Supplied with: •Carry case •R5232 lead •Software on 3.5" disc •Leads •Instruction manual. Note: Current model does not have an inbuilt temperature probe. See 96 Cat, page 28 for full details.

Cat. QM-1260 **Was $239.50**

February $199.50 Save $40.00

OFC SUPER FLAT SPEAKER CABLE

7 x 48/0.10mm. OD 11 x 2 x 11mm. See 96 Cat, page 119 for full details.

Cat. WB-1738

Cat Price $5.95 mt.

Feb Sale $3.50 mt.

30M ROLL 75Ω CABLE

3C2V light duty coax. Black in colour.

Cat. WB-1999 **Cat Price $16.95**

Feb $10 Save $6.95

RECORDABLE CD's

Quality KAO Brand.

Cat. XC-4710

Feb $20

10 For $175.00

COMPUTER SWITCH

2 WAY D25 SERIAL TYPE IN METAL BOX

Cat. XC-5062

Cat. Price $24.95

Feb $12.50

1/2 Price

4 WAY D25 SERIAL TYPE IN METAL BOX.

Cat. XC-5071

Cat. Price $49.95

Feb $20.00

Save $29.95

DRILL BIT PACK

Includes: 1x3.0mm 3x3.5mm 2x4.0mm 4x3.175 mm (1/8')

Cat. TD-2405

Cat Price $14.95

Feb $8.95

Save $6.00

REED RELAY BARGAIN

SPST 12V magnetic shielded . •2.54mm •nom volt: 12VDC •coil resistance: 1050Ω •nom input power: 138mW •must operate volt: 8VDC •must release volt: 0.8VDC •max voltage: 22VDC •case size: 22.8(L)x8.7(H)x8.8(W)mm.

Cat. SY-4035 **WERE $2.00ea**

Now $1ea or 10 for $5

MICROPHONE CABLE

Single core, black PVC with cotton filler. Size 14 x 0.18mm. Conductor OD 4.6mm

Cat. WB-1520

Was $1.70mt.

$166 per 100mt. roll.

Feb. $65 Roll or $1 per mt

COMPUTER SERVICE TOOL KIT

kit includes: •IC inserter •IC extractor with securers •Pin vice •Tweeters •1/4", 3/16" nut screwdriver •T15 torx screwdriver •Parts tube for storage •#1 and #0 Philips screwdriver •1/8" and 3/16" slotted screwdriver •Zipper case •Size 220 x 155 x 38mm

Cat. TD-2040

Was $25.95

Feb. $16.95

Save $9.00

AMAZING BARGAIN WORLD TRANSISTOR COMPARISON TABLES

1/2 PRICE

Vol 1 (A-Z)

This comparative data book (Vol 1) contains more than 11,000 different transistors and FETs all of which are listed alphabetically. Each page is divided into 3 sections:- The description part with the columns - type, material, polarity and desc of application. The data part with the most important ratings, divided into clear columns, and a drawing of the corresponding case with the connection sequence. The alternative - type part, listing, as far as possible, the most suitable alternate types. Softcover. 270 pages. 215 x 147mm.

Cat. BM-4584 **Was $18.95**

Vol 2 (O - µ)

This volume contains more than 15,000 devices. It includes 2N, 2SA, B, C, D, 2SK, J Mosfets and more. Softcover. 430 pages. Size 215 x 147mm.

Cat. BM-4585 **Was $18.95**

BUY VOL. 1 & 2 FOR THE PRICE OF 1

$18.95 FOR VOL1 & 2

RF SIGNAL GENERATOR

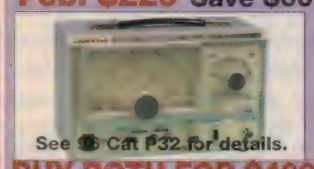
Cat. QT-2312 **Was $289**

Feb. $229 Save $60

AUDIO GENERATOR

Cat. QT-2310 **Was $289**

Feb. $229 Save $60



See 96 Cat P32 for details.

BUY BOTH FOR $439

HOBART STORE OPEN 9–4 SATURDAY

DATABANK CALCULATOR WATCH

Three line databank which will store about 50 names and phone numbers - 1.4k memory - secret lock function - 5 tone. Up to 10 alpha characters and up to 20 numerals.See 96 Cat, page 169 for details of this amazing watch.

Cat. XC-0260

Was $19.95 **Feb $12.95** Save $7

Jaycar ELECTRONICS

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PHONE: (02) 9743 5222
FAX: (02) 9743 2066

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ROAD FREIGHT ANYWHERE IN AUST (up to 20kg) $14.00

POST & PACKING $10 to $24.99=$4.00 $25 to $49.99=$5 $50 to $99.99=$7 OVER $100=$8

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CANBERRA ACT •11 Kambla St. Fyshwick •Ph:(06) 239 1801 •Fax:(06) 239 1821 •Mon/Fri:9-5.30 •Sat:9-1pm

MELBOURNE CITY •Shop 2,45 A'Beckett St•Ph:(03) 9663 2030•Fax:9663 1198 •Mon/Fri:8.30-5.30 •Fri:8.30 •Sat:8.30-4 •Sun:10-4pm

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SYDNEY CITY •129 York St •Ph:(02) 9267 1614 •Fax:(02) 9267 1951 •Mon/Fri: 8.30-6pm •Thurs:8.30pm •Sat:9-4pm

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GORE HILL •188 Pacific Hwy Cnr. Bellevue Ave •Ph:(02) 9439 4799•Fax:(02)9439 4895•Mon/Fri:9-5.30•Thurs:8.30•Sat:9-4•Sun:10-4

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HOME AUTOMATION: PAST, PRESENT & FUTURE

Way back in the sixties and seventies, we thought intelligent electronic control of our houses was just around the corner. It didn't happen, although we all got a small degree of automation: automatic washing machines, pop-up toasters, remote controlled televisions and video recorders arrived. Finally, however, in the nineties, full home automation is available, practical and affordable.

by GRAEME KELLY

Those of us old enough to remember, will recall being amazed by the early digital watches and calculators. I remember reading about Stirling Moss' London house — automated, it was rumoured, at a cost of about £500,000.

Many people, including myself, assumed that the use of electronics to control lights, appliances, monitor security and our home environment, was imminent. In fact, Steve Wozniak's classic design of the Apple II computer was largely influenced by his conviction that its main use would be to control home automation. It never happened...

Actually, it was in Fife, Scotland in the early seventies, that the big breakthrough in home automation occurred. The two founders of a tiny electronics firm called Pico Electronics had just developed one of the very first electronic calculator chips. Their second successful device was a long-playing record deck called Accu track, which used a LED/photodiode combination to detect the breaks between the tracks of the record, so that a user could select any track, just as we do today with CD players — a disk jockey's dream!

It even had an ultrasonic remote control. This remote control transmitted bursts of codes at 40kHz, the second burst being the inverse of the first. It was from here that the X-10 system of sending low voltage digital signals through 110V or 230V power lines evolved.

Today, worldwide, there are over 450 manufacturers making more than 1500 home automation products, and these have gone into more than 4,000,000 homes in North America alone. The majority of these products use the X-10 protocol or are X-10 compatible.

Australia's home-grown Jeeves system is based on the well proven X-10 technology, which sends digital codes over the 240V power line. The young woman is demonstrating the Jeeves programming console. (Courtesy The Smart Company)

Systems and standards

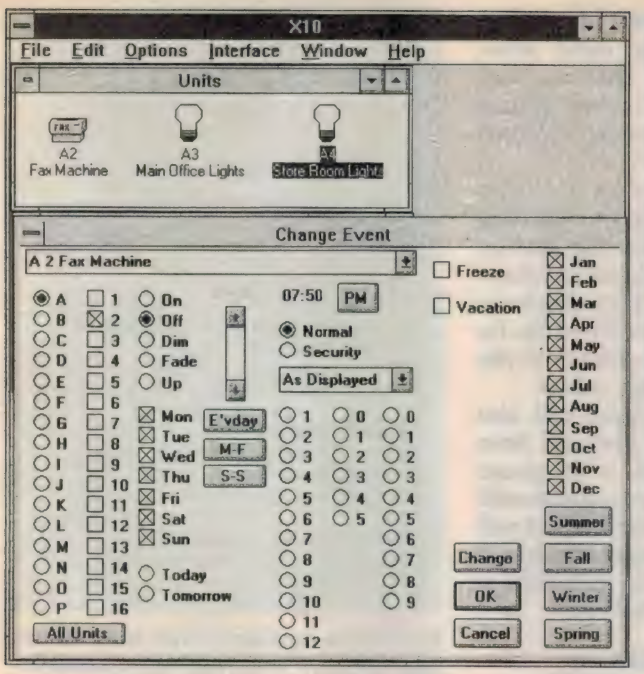
As happens in many industries in the early stages of development, many systems and standards emerge. Remember the Beta/VHS battle, in the early days of video cassette recorders? The fledgling home automation industry is no different, and since the X-10 system was originally developed, several groups supporting specific systems and standards have formed. Let's look at some of the more popular systems.

Smart House: Many of you will have heard or read about this proprietary standard, developed by the National Association of Home Builders in the USA. Supported by investments and levies from much of the American home building industry, this system is second in the marketplace to X-10.

The Smart House system uses a licensed product concept with its own wiring, fixtures and equipment, and uses specially trained installers and service personnel. Extensive shielded cabling containing six low voltage control wires, two coaxial cables and three mains power wires is common. Sometimes 12V DC supply cables are included to power electronic devices around the home.

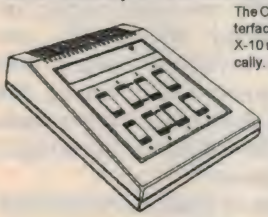
The cables are not normally terminated in the Smart Outlets around the house, but the insulation is pierced in a similar fashion to a modular phone plug or IDC connector. There are interchangeable duplex modules in most Smart Outlets allowing a choice of video/audio devices, telecommunications, and computer controlled mains power.

The Smart House concept is expensive and is primarily aimed at new houses, although retro fit products are now available. The full system with a centralised controller, hard wiring and mod-

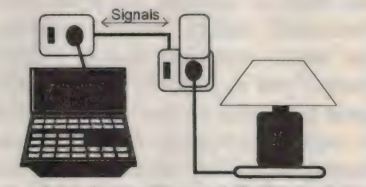


Shown above are some of the components used in the Jeeves system. (Courtesy Smart Company) At left is the window used to program timed events from a PC, for downloading to an X-10 controller, while below are (L to R) an X-10 Computer Interface, the way control is achieved via power lines, and the Plug 'n Power controller. (Courtesy Midac Technologies)

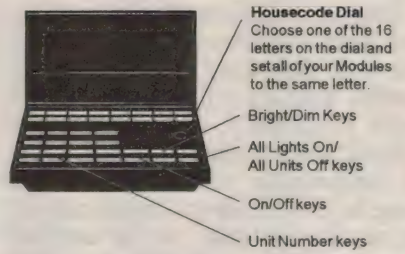
CP290 Computer Interface



The CP290 computer interface is used to control X-10 modules automatically.



Command signals are sent over existing house wiring



ular outlets can add up to $50,000 to the cost of building — but its quality, capabilities and reliability set a hallmark for other systems to reach.

CEBus: This standard was developed by an extremely powerful group of electrical and electronics manufacturers, including AT&T Bell, Compaq Computer Corporation, Hewlett Packard Company, IBM Corporation, Microsoft, Inc., Sony Electronics, Inc., to mention just a few. No shortage of capital here!

CEBus is based on the concept of local-area-networks (LANs) for the home. It is a two-way system, and it tells manufacturers what their products must do to send and receive CEBus-compliant messages through a home LAN. Its options include signals through powerlines as in X-10, four pairs of phone wires, dual coaxial cables and both radio frequency (RF) and infrared (IR) transmissions.

Being interactive, CEBus has many advantages. For example, security sensors can provide status reports using 'picture within a picture' (PIP) techniques on the home television, and automatically perform tasks such as turning off lights and turning down heating or air conditioning in unoccupied rooms.

Because CEBus provides for the same speed for control signals whichever transmission media is used, the system doesn't need the complexity of buffers when passing signals from one medium — say powerline — to another such as RF. CEBus doesn't require dedicated chips. Manufacturers are free to use the microprocessor of their choice, which tends to streamline development and production costs.

As with Smart House, CEBus is much better installed in a new home while it is being built, although much of it can be retro-fitted relatively easily.

Echelon: Affectionately known as 'LON' by its devotees, this has been operation since 1988. It is a proprietary system based on a few specialised computer chips known — wait for it — as LON chips.

The LON approach also allows multiple devices to communicate through any of the methods used by Smart House or CEBus. The main difference is the language and protocols used. Its standards are more technically advanced than X-10, especially in communications. Some features of Echelon should be compatible with CEBus, but only time will tell.

Echelon is, to my knowledge, unavailable in 230 volt versions, so isn't used at present in Europe or Australia, and is unlikely to be in the foreseeable future.

X-10: This standard, founded on the products of the manufacturer of the same name, is the de-facto world home automation standard by virtue of being the first (1978) and by the sheer variety and volume of X-10 and X-10 compatible products in existence. Many firms such as Sears, Radio Shack, Stanley Tools, Leviton and ACT manufacture or market X-10 compatible products. This is despite the fact that the X-10 products cannot easily communicate two-way, as most of the newer systems are capable of doing.

X-10 systems employ their own powerline carrier protocol, basically unchanged for 18 years. Here is a brief summary of the X-10 powerline transmission theory, for the technically minded.

The X-10 RF digital transmissions are between 5 - 7V and are sent in short 120kHz bursts synchronised so as to be as close as possible (within 200 microseconds) to the zero voltage crossing points of the home's AC mains. A binary 1 is represented by a 1ms burst at the zero voltage crossing point, and a binary 0 by the absence of this burst.

A complete coded signal covers 11 cycles of the AC powerline. The first two cycles (four zero voltage crossings)

represent a *start code*. The next four cycles transmit the *house code* (there are 16 different house codes, A to P in the X-10 system), and the last five cycles represent either the receiving unit's *number code* (1 through to 16 for each house code) or a *function code* such as ON, OFF etc. This complete block is always transmitted twice, with three power cycles between each group.

BRIGHT and DIM commands are exceptions to this rule, and are transmitted at least twice continuously with no gaps.

Within each block of data, each four- or five-bit code is transmitted in true compliment form. In other words, if a 1ms burst of signal is sent on one half-cycle (binary 1), then no signal is sent on the following half-cycle (binary 0). The start code is always 1110, which is a unique code and the only one which doesn't follow a true complimentary relationship on alternate half-cycles.

The start code alerts all receivers that a command is coming; the house code and unit code determines which of the 256 possible receivers will carry out the command. A normal X-10 command signal will take half a second to transmit.

Unfortunately, one drawback with using the powerlines as a signal carrier is the amount of 'noise' on an unfiltered powerline. Home wiring is not shielded, so can act like an antenna. Other interference can come from appliance motors, televisions, computers and fluorescent lights. However, despite these drawbacks, the X-10 system functions very reliably and the receivers will operate when the 5 - 7V RF signal is attenuated down to as little as 100mV.

The great advantages of the X-10 system are the enormous variety of hardware and software available, the fact that no dedicated wiring is needed, and the affordability of the components. For example, an X-10 wall dimmer light switch retails for about $25 — about what you would pay for an ordinary dimmer light switch.

However, the X-10 switch will also respond to on/off/dim commands from any telephone (through a telephone transponder), or can be pre-programmed by a computer using an interface and will then operate with the computer turned off. The home-grown Australian JEEVES system is based on X-10 technology.

What'll it do for me?

Well, if you're an invalid confined to bed then the benefits are pretty obvious. You could control virtually everything in the house from your bed or wheelchair. Even if you're perfectly fit, wouldn't it be great to be able to turn on the electric jug or coffee percolator, raise or lower the heating or lighting while reclining in your favourite chair watching TV.

There are potential cost savings, too. Many power authorities offer 'Powersaver' packages which give greatly reduced tariffs between 11pm and 7am. If you have a separate kitchen water heater, why not have your main hot water cylinder only re-heat at night ready for piping hot showers in the morning? If you do want lots of hot water during the peak power period occasionally, you can always override the controls with one click of your wireless remote. Why not load your dishwasher, clothes washer and drier and have them run late at night on the cheaper power?

My units of power used between 11pm and 7am at 62% of the normal tariff, often exceeds the units used during the normal tariff times. This more than compensates for the two watts that each module consumes while waiting for a command.

But the best reason of all for installing home automation is simple: It's fun!

Like most automaters, I started by buying an X-10 compatible security system. As well as having 16 zones, autodialler and all the usual features, the keyring control that armed and disarmed the alarm also had buttons for turning on and off the front hall light. The security console also doubles as an X-10 controller, converting X-10 RF signals to X-10 powerline commands.

Adding a telephone responder enabled me to control all my lights and appliances from any tone-dial phone. It's marvellous in the middle of winter to be able to turn the heating as I leave work!

In no time, with the aid of an electric door strike, the Light On button on the keyring was unlocking my front door before I had even reached it. (Great if your arms are full of groceries...) A light switch immediately inside the door allows me to turn on all the lights or the just the kitchen, lounge and main bedroom lights, or just one of them. When I leave for work in the morning, the same switch allows me to

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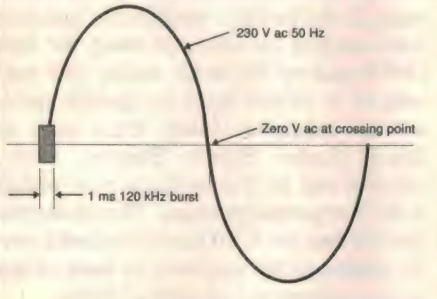
PO Box 281, Te Kuiti, New Zealand.
(NZ distributor of X10 systems)



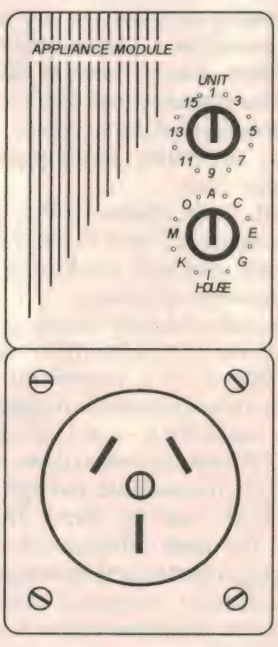
How the 1 microsecond 120 kHz 5-7 volt X10 signal is timed

Start Code	House Code	Number Code	Start Code	House Code	Number Code

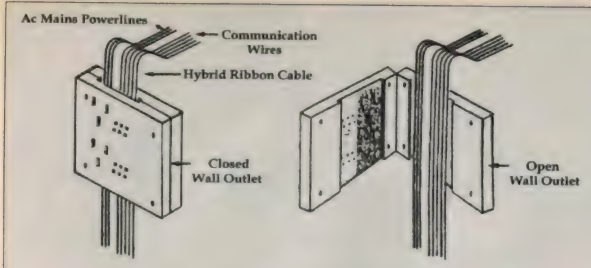
230 V ac Powerline Cycles
11 — 2 — 4 — 5

Start Code	House Code	Function Code	Start Code	House Code	Function Code

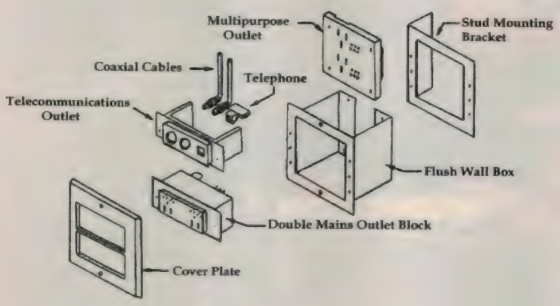
Code transmitted when a Number or Function button is pressed



In the X-10 system control codes are sent over the power line in one millisecond bursts, synchronised with the zero crossings. At right is the layout of an X-10 appliance control module, with its unit and house 'address' controls. (Courtesy Midac Technologies)



SMART Ribbon Cable Multipurpose Interface



SMART Multipurpose Outlet For Separate Cables

The Smart House system uses its own wiring, features and equipment. It uses a special hybrid ribbon cable, with the power outlets connected to it in 'daisy chain' fashion using a system like that for IDC connectors.

turn all the lights off with one flick...

Once settled in my 'Lazy Young Person' recliner in front of the TV, I had the problem of accommodating three audio/visual remotes, the lighting remote, the appliance remote and the cordless telephone. Technology overload! However, the cordless phone can replace the two X-10 controllers, and when I buy the appropriate IR X-10 units, I'll be able to control the audio/visual gear with the cordless phone.

If I programme the phone's memory, I can even carry out a 'macro' — that is, a programmed series of commands. For instance, dim the lights, turn on the heating, turn off the radio and turn on the TV. There are macro modules available too that can do all this and more.

My personal computer, while mostly used for more serious stuff, also controls my home's minor tasks by means of an interface plugged into its serial port. This means that I can programme up to 120 events using one of the many X-10 software programmes available. Events can be programmed for seasons, months, all year, everyday, weekdays only, weekends only, today only or tomorrow only, at one minute intervals. I can programme incandescent lights to come on at 6%, 12% brightness or whatever, or to go off suddenly or progressively fade out.

Now that X10 has released two-way modules that interface with the powerline, it is possible to know the on/off/dim status of any receiver — so opening the way for the 'if', 'or' and 'when' type of macro programming, and overcoming one of the deficiencies of the X10 system.

As there are no changes to permanent wiring, X-10 systems are easy to install and easily programmed. (Courtesy Midac Technologies)

And the future?

My pick for the immediate future is that the X10 system will continue to dominate and grow. However, in the longer term, I would guess that the CEBus system will eventually win out.

Another growth area will be the incorporation of automation receivers in home appliances at the time of manufacture. Indeed, one large Korean manufacturer already offers these as an optional extra in selected appliances on the North American market.

Well, it is often said that if the human mind can conceive it, something will eventually be made. In the field of home control and automation, today's wish list will be tomorrow's reality! ❖

Continued from page 45

ing numbers. For example, to multiply a number in a shift register by four, you simply shift the whole number to the left by two positions. Here's an example: we know that 3 x 4 = 12. In four-bit binary, the decimal number three is 0011. Shift it two positions left and you get 1100, which is binary for 12.

Dividing is equally simple. For each power of two you wish to divide by, you shift the register one position to the right. Example: we know that 8 divided by 8 is 1. The four-bit binary for decimal eight is 1000. To divide it by eight, we shift right three places — giving us 0001, which is one.

Of course, this is a very simplistic example, which caters only for powers of two and doesn't look after remainders or overflows. But it gives you the general idea, that we'll work on in a future issue.

Divide-by-three

While we're in the mood for dividing, the D-type flip flop is great for dividing a frequency down by powers of two (i.e., 2, 4, 8, 16 etc), but what about other numbers? The circuit in Fig.6 divides the incoming frequency by three. Using one of these and some further D flip flops, you also get the option of dividing by 6, 12, 24 etc. Using two divide-by-3's and some flip flops you can get 3, 9, 18, 36 etc — you get the idea.

The circuit here uses two flip flops and an exclusive-OR (XOR) gate. The two flip flops are connected in the same way as our counter in Fig.3, except that the output of IC2b is coupled back to one of the inputs of the XOR gate.

While you would normally expect two flip flops to divide by four, the XOR gate effectively inverts the clock signal every time the output of IC2b changes polarity or state. The XOR gate acts as a buffer when the output of IC2b is low, and an inverter when it's high. This change effectively causes the output of IC2b to change state every one-and-a-half input clock cycles, so we get a complete output cycle every three input cycles. This changing of the clock signal polarity causes the whole circuit to divide by three instead of four.

Well, that's enough for this month. We've covered some new areas in a short space and you'll get just as good value by building up the circuits and having a play around for yourself. Again, while they might not set the world on fire for being scintillating circuits, they do lay down the foundations for what lies ahead.

See you next month, for some more circuits. ❖

DELCO'S NEW 'GEN-V' CAR MANAGEMENT SYSTEM

Until now, electronic systems in cars have been a collection of separate and largely disconnected subsystems — each monitoring and controlling its own function. But leading international auto electronics specialist Delco Electronics has now developed a fully integrated system, in conjunction with Mercedes Benz and data acquisition specialist Pi Research. The new Gen V system has been successfully trialled on the Penske and Rahal team cars in last year's IndyCar Championship, and is claimed as the 'next generation' of auto electronics systems.

In these days of increasingly restrictive regulations in motor sport, it has never been truer that 'knowledge is power' when it comes to extracting the best performance from a racing car. Data acquisition systems have been the primary source of this information at the top end of motor sport for some years now, and are now an essential part of the performance package. However, as potential gains in performance fall into the low percent or even sub-percent level, the challenge now is to make more effective use of this data.

Conventionally a racing car's electronics system has been a collection of separate units (engine management, data logger, gearbox controller, etc), usually involving different tools for updating setups and viewing data — sometimes even duplicate sets of sensors! However Delco Electronics have built on their experience in engine control modules (ECMs), and in extending this to other functions on the car, have taken a deliberate 'systems approach' to the design.

The result is the recently introduced Delco 'Gen V' system, developed in conjunction with Mercedes Benz, and currently being used in IndyCar racing. The system treats the vehicle electronics system as a single integrated controller, with the intention of offering a powerful, flexible and consistent tool for the race engineer to develop the performance of the car.

Flexibility

The Gen V system is based around an in-car digital communications network operating at 20Mb/s (20 million bits per second), and designed specifically to meet the flexibility and reliability requirements of motor sport. This network links a number of 'intelligent junction boxes' distributed around the car, which perform all the acquisition and control functions. Each of these junction

boxes provides information to the Master Control Unit, which performs all the necessary computation and logging functions.

The vehicle network allows the race engineer to add or remove logging or control functions from the car, by simply adding or removing junction boxes from the network. This allows quick experiments to be performed on a test car, or major changes to the logging functions on the racing car between practice and race sessions, without any changes to the main wiring harness.

The network also has the effect of making any data measured anywhere on the car available to any other point on the car. In this way, complex multi-variable control schemes can be implemented without an 'explosion' of additional wiring on the car. All the Gen V wiring installations so far have resulted in less complex, lighter and neater harnesses, with the possibility of some associated gains in reliability.

Ease of control

Central to the Gen V design is the idea of giving control of the operation of the racing car's electronics to the team and the engine manufacturers. In order to achieve this, the software is constructed in a way not dissimilar to a desktop PC. The Gen V uses its own operating system in much the same way as a PC uses Windows, allowing an engineer to write code or run existing applications without knowing the details of the hardware he is running it on.

This has been used to good effect by Mercedes, where they have completely specified their own engine control algorithm rather than accept the one supplied by the ECM manufacturer. This has then been implemented in 'C' code and 'plugged in' to the Gen V operating system.

It is common knowledge in the software world that use of a high level software language such as C yields tremendous benefits in terms of ease of modification and reduced incidence of software bugs. However, aside from the Gen V it is still relatively uncommon to find ECMs that make extensive use of high level languages, usually due to the limitations of the processors in the system.

Team Penske have taken the flexibility of the Gen V system one stage further, by writng their own code for the unit. This allows them to generate or modify software during a test session at the track — to try out a new control strategy, change the driver information etc. This rapid prototyping process, coupled with the extensive input and output facilities available in Gen V, allows the team much more flexibility to explore potential areas of gain in the car's performance.

Processing power

The adage has it that 'Power is nothing without control'; however in this situation the converse is also true, that 'control is nothing without power'! The requirements of an advanced engine control algorithm, teams writing their own control applications, and the overhead of using an operating system and high level languages, place quite a demand on the processing capabilities of the Gen V hardware.

Delco have provided the necessary processing 'horsepower' by using an array of transputer chips to do the bulk of the computation. These are devices more often found in supercomputers, and give the Gen V a throughput of at least 20 times its predecessor. The system also offers a total of 30MB (megabytes) of memory, for logging and control operations. This allows the system to perform very fast re-calculation of ignition and injection control algorithms — which would possibly account for reports from the test drivers that they have experienced an improvement in drivability.

Precision control

The Gen V system is claimed to be unique in motor sport for employing a patented closed-loop injector drive scheme. This system continuously monitors the performance of each injector, and compensates in real time for the effects of fuel pressure, battery voltage,

Gen V tech details in brief

Delco's Gen V system is designed to be easily extendable by adding on additional intelligent junction boxes. The specification outlined below shows the configuration currently available to the IndyCar teams:

Control
- 20 injectors (closed loop control)
- 10 high energy sparks
- Engine control algorithm by Mercedes Benz (operating to 18,000rpm)
- Turbo boost regulator
- Electronic 9th butterfly controller
- 'Shift without lift'
- Permanent magnet alternator controller
- Weight jacker control

Logging
- 16MB logger
- 10Mb/s download
- 550 channels
- Microwave telemetry
- Real-time telemetry
- Engine log book
- Infra-red lap beacon

Driver information
- High contrast dashboard (10 numeric fields with separate race/practice pages)
- Bargraph type shift lights
- Audible warning system
- Multiplexed steering wheel switches
- Head-up display interface

Sensors
- Tyre pressures & temperatures
- Laser ride height
- Three-axis accelerometer + gyro
- Four Moog valve outputs
- Four UEGO lambda sensors
- Four exhaust thermocouples
- Four wheel speeds
- Four strain gauge inputs
- Miscellaneous temperature, pot & switch inputs

During a frantic pit stop, the Rahal Racing team are able to monitor the car's progress using the Delco Gen V System. Opposite is the 96 Penske Mercedes IC108C.

DELCO'S NEW 'GEN-V' CAR MANAGEMENT SYSTEM

Gen V: The user's perspective

Paul Morgan, co-owner of Ilmor Engineering (the racing engine manufacturer for Mercedes Benz) has been involved in the project almost from its inception. He explains the importance of electronics to their engine development:

"Delco, in association with Pi Research, have produced a fuel management system that is small, powerful and flexible enough to last beyond the end of the decade. We have seen immediate benefits in ease of packaging in the confined space of an IndyCar, and the ease with which software changes can be executed in the field."

At the end of the day the driver is the end user for all the car systems. The Penske team; and in particular Emerson Fittipaldi, were a key part of the early testing and development of the system. He presents the driver's view of the system:

"The electronics are important on a race car, although I don't think it will have much effect on top end power; the pickup and drivability is also important. In early testing when we changed to the Delco Gen V, I noticed better pickup from the car — it was more 'snappy'. I guess the computer must be working harder!"

temperature, etc. — without the need for selecting matched injectors or relying on individual injector calibrations.

The result is more precisely metered fuel to the engine, and better fuelling distribution, as has been demonstrated on a fuel measurement rig. It also offers the advantage of detecting a failing fuel injector, which apparently has saved Mercedes burning pistons in pre-season testing.

The precision of the control algorithm calculation in Gen V is also supported by the use of floating-point calculations throughout, together with the almost universal use of 12-bit A/D (analog to digital) converters for critical inputs.

Pit communications

The Gen V communicates with PCs in the pit area via the Delco telemetry radios, or via a 10Mb/s wire link when the car is in the pits. The pit system is the race engineer's 'window' to the car system and will be used by him to determine the performance of the car, and the areas to improve upon. Optimum presentation of the vast quantity of information supplied by the Gen V system is obviously key to this decision making process.

Delco Electronics have commissioned Pi Research, recognised world leaders in the field of data acquisition, to supply the PC software to work with the Gen V. This includes the V6 analysis tool, which allows an extensive range of views of the data including Fast Fourier Transforms, cross-plots, bar graphs and time plots. The system also includes a calibration tool which allows editing of system parameters as a 3D graph in real time, whilst the engine is running!

In this area too, Delco have insisted on an integrated approach to the design. The various components of the PC software are all designed to work together under the Windows 95 operating system, and are based around a single central car database.

The intention is to build on this concept still further, to integrate the race engineer's setup data into the database, and combine this with a simulation of the race car. This vehicle model, currently under development at Pi Research, 'learns' about the car from the information acquired by the Gen V, to become sufficiently close to the real car to allow the teams to run a 'virtual' track test!

The use of Ethernet networking of the pit PCs extends the accessibility of the data from the Gen V to multiple users, all of whom can individually customise their views of the data for the area they are particularly interested in. This information sharing concept also allows the team's computer to receive data from the car in real time via the Gen V telemetry systems, and from this information, suggest to the team a strategy for tyre and fuel stops, and optimum fuel trim. The Delco track support engineers extend this pit network even further by making use of the Internet to transfer data, calibrations and test information back to their base in the USA.

The development of the pit system has been done in close conjunction with Mercedes Benz track support engineers to optimise the speed of operation, flexibility, and ease of use of the system.

Lightweight packaging

The reduction in wiring offered by the vehicle network, the reduction in number of units on the car, together with the use of magnesium in the unit housings, offers weight savings in the region of 5kg over conventional systems. The system makes intensive use of integration of functions to reduce the packaging. The MCU features integral spark box, and even internal lap beacons if required. The dashboard includes a data logging junction box, as does the alternator control module.

In total, the system contains in excess of

The transputer-based Delco Gen V System is a major step forward for integrated control — providing engine management, data acquisition, chassis control, driver information, telemetry and alternator control functions.

Delco Electronics joined forces with Mercedes Benz to develop a leading-edge controller, working together to provide a high technology system that's powerful and flexible.

3000 electronic components (some with a lead pitch as fine as 0.5mm), mounted on PCBs of up to 12 track layers. Packaging this design and mounting it in a race car where 100G peak accelerations and ambient temperatures up to 100°C are frequently seen, represents a major engineering challenge. Delco have made use of aerospace technology and highly skilled technicians from the F16/18 fighter programmes to produce the system with the required level of reliability.

The future

Even though Gen V is currently running on five cars on the Indy grid, Delco sees this as only the starting point for further development of the Gen V system. They have a large research facility looking into advanced systems for the commercial automotive market. Currently their projects include collision warning, airbags, advanced combustion control and 'head up' displays. There are obviously good opportunities for Delco, working in conjunction with Mercedes Benz, to make use of this technology in the motorsports arena.

Faced with increasingly tight regulations, teams at the top end of motor sport are putting an increasingly high expectation on electronics and 'smart' systems to provide a performance gain with the car. Delco seem ideally placed to meet this challenge with their Gen V system — its power and versatility could represent the next GENeration for motor sports electronics! ❖

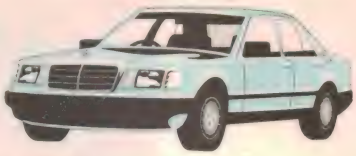
Delco and motor sport...

Delco Electronics is a major supplier of electronic components and systems to the automotive industry, and through their partner Hughes Aircraft into the avionics arena. They employ 28,000 personnel, spread over 33 sites in five continents. Delco's focus is on supplying electronic control modules to the commercial automotive market, and in 1995 they supplied in excess of seven million electronic modules.

The firm's involvement in motor sport started in 1990 with the release of the Gen III engine management system. This was used with considerable success in both IndyCar and IMSA racing. The Gen III was superseded by the Gen IV engine management system in late 1992. This new system featured a more powerful i processor and additional memory. The Gen IV has also seen a good deal of success, including two Indy 500 victories.

However by 1994 it became apparent that the Gen IV was too limited in its processing capabilities, and Delco started to explore the possibility of a next-generation engine management system — but this time, one that formed part of an integrated vehicle electronics system. The resulting Gen V system has been a joint development by Delco Electronics and Mercedes Benz, and in 1996 ran on the Penske and Rahal cars in the IndyCar championship.

AUTOMOTIVE ELECTRONICS



with JON LOUGHRON Assoc. Dip. Electronics

The Wolf 3D Engine Management System - 1

After-market injection and engine management systems have been around for some time, but this month we look at the Wolf 3D engine management system manufactured by Advanced Engine Management (AEM). This sytem is a little different from most after-market systems, because it was one of the first systems that can be tuned from a plug-in handheld controller (which can be dash mounted as well), instead of a PC. This means on-board diagnostics and tuning is available at any time.

The Wolf 3D system is a very practical and cost effective 'performance' control system. The word performance is in inverted commas here because it must be remembered that there are emission standards required by law. You cannot exceed these without facing substantial fines — so if you cannot guarantee that the modified engine and control system will meet the emission standards, I suggest that all modifications and tuning should be carried out by a qualified technician/workshop with suitable test equipment. The installation of the wiring, ECM and devices can still be done yourself, as the manual supplied with the system is very comprehensive. This applies to all after-market systems, not just the Wolf.

Fig.1 shows the Wolf 3D hand controller and ECM.

Fine tuning of the system to get maximum efficiency has to be done on a dynamometer, as maximum power and efficiency can only be achieved by running the engine under load and then checking power output, emissions, etc via an engine analyser and four-gas analyser. Each time the parameters are adjusted the vehicle is again run on the dyno to ensure that correct ignition timing and fueling is achieved.

Although there is an option, where an O_2 sensor can be installed into the exhaust system to see what is happening, ideally a four-gas analyser is the best way to see what the engine is actually doing.

This of course does not imply that the Wolf 3D system cannot comply with emission standards for a road going vehicle — because after all, it is fully adjustable. In fact when tuned properly, the system will ultimately provide much better control of fuel and spark than carbies and points (and some EFI vehicles). I've just drawn attention to the need for proper tuning and analysis because I believe it's important to keep you informed when legalities can be infringed. Although it's nice to have a few extra ponies under the bonnet, it's worth remembering that (and I say this again...) the law *is* the law.

Road and track

The Wolf 3D system is equally at home on the road or in the racing environment. I was speaking to the designers at Wolf and they were saying that some people use the system on their road car to drive to the race meet, whip it out when they arrive, attach the racing memory cartridge, install the unit into the racing beast and off they go — no need for two units. This is not so good for AEM's sales, but it definitely shows the flexibility of their system...

The ECM can be configured to suit many four-stroke applications. This includes turbo or super-charged four, six, and eight cylinder engines — and for the fans of rotaries, yes, there is a special mode included just for you guys! The rotary engine mode includes split-ignition timing for leading and trailing plugs (a very impressive feature), and staged injection as well.

The specifications state: 'Suitable for rotary, 1 to 12 cylinder engines and for two-stroke and other applications it is best to contact AEM'.

A very interesting feature of this system, as mentioned in the introduction to this article, is the fact that the programming of the fuel and spark curves is done by the remote hand controller (See Fig.2).

The hand controller has a back lit LCD screen, two LED indicators and an eight-button keypad. It plugs directly into the ECM, which means that no PC is required to program the system. A relatively simple menu system is used to access and change the MAP and LOAD points.

The hand controller can be mounted on the dash and feedback of particlar inputs and outputs can be displayed on the screen. On the side of the hand controller are two switches, which change the backlight brightness and LCD contrast.

Fig.1: The Wolf 3D ECM and hand controller. Once the menu screen is entered, loading information or changing set points can be done without connection to a PC.

Security code

The system can be set to have a security mode, which not only stops the engine from being started but also denies access to any of the user defined parameters.

If the security mode is enabled and if the ECM module is powered up (ignition key switched on) a security code must be entered. This gives the bonus of complete security for the vehicle and ECM, because the vehicle cannot be 'hot wired' — the ECM shuts down all functions.

Maybe vehicle manufacturers should consider a similar coded/PIN number security device. Although some new vehicles have a fairly sophisticated and complex lock/disable system, not many have an individual PIN number.

There is a warning in the manual regarding the PIN number and it says that before applying power to the Wolf 3D ECM, you should read the section regarding security PIN number programming. The PIN number can only be set once, and it cannot be modified without returning the unit to the place of purchase. The added bonus of this, apart from the vehicle being protected from unauthorised starting, is that if the ECM is stolen (unlikely — but stranger things have happened), it will not work in another vehicle...

The user does not *have* to set the PIN security mode, by the way, as the ECM will operate normally without ever having the security mode set.

The Wolf 3D system has more diagnostic features, which are not limited to information provided on the LCD of the hand controller. On the side of the ECM next to the memory cartridge plug are six LEDs (see Fig.3). These LEDs indicate whether the ECM has power connected, if an input trigger is being received, output switching to the injector banks 1 and 2, and injection mode (that is, staged injection enabled or disabled) and an output trigger to the ignition system. This allows very fast diagnosis of problems, because at a glance you may be able to pick a problem with the system's peripherals or wiring.

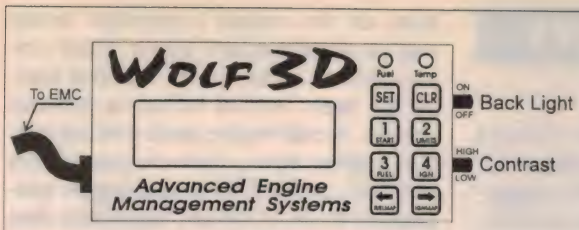


Fig.2 (left): The layout for the Wolf 3D hand controller. Notice that entering the menu system can be done by pressing the fuel and ignition buttons. The up and down adjustment or sub-menu selection can be achieved by pressing the arrow keys.

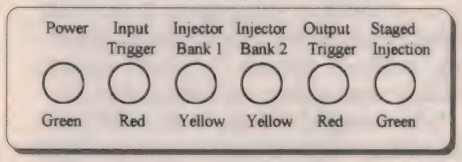


Fig.3 (right): For quick inspection and diagnosis of a problem, indicator LEDs are provided on the side of the ECM case.

Functional description

The ECM uses fuel and ignition 'maps' to determine the engine's fuel delivery and ignition timing requirements under a wide range of load and rpm values. The fuel injection map is three dimensional, with the horizontal axes being engine load and RPM, while the vertical axis represents the injection duration. The ignition map is very similar in configuration, except now the vertical axis represents ignition advance in relation to crankshaft position, instead of injection duration.

Both of the fuel and ignition maps are divided into load and RPM bands. The engine load is divided into a scale from 12 - 100% in 12% steps, while the rpm can be adjusted across a range from 500 - 8000rpm in 500rpm steps. If the rpm is greater than 8000, the fuel delivered and the ignition timing given to the engine are the same as the 8000rpm values.

Fig.4 shows the rpm versus load map relationship.

There are four ways of modifying the fuel maps. These are:

1. Nearest injection map point: which as it states adjusts the nearest map point.
2. Load band move: this function moves the entire load band by a certian offset, but keeps the curve intact.
3. Load band reset: this flattens the fuel curve at all rpm points on the patriclular load band. It states in the manual that 'This is a powerful function that should only be used either before any fine tuning has begun, or if the user is completely lost'.

(It is nice to know that the designers have realised that not all of the planet may be inhabited by EFI whiz kids, and recovery is important for us mere mortals. This is one of the aspects I find good about the Wolf 3D. Apart from making recovery easier, it also seems to have been designed to make getting an engine running relatively easy. Then all you have to do is get familiar with the menu system and fine tuning, and the fun begins!)

4. Injection scale adjust: this allows the user to set up the finest steps between injection values within the fuel map.

As with the injection programming modes, there are also four ways of modifying the ignition map. These are similar to the injection map adjustments, and are listed below.

1. Nearest ignition map point: this is identical to the injection function and it allows the user to set one map point at a time.
2. Rpm band move: this allows the user to offset all eight load points on the rpm band, maintaining the ignition curve for the entire load range.
3. Rpm band reset: this allows the user to flatten the ignition curve at all load points on that rpm band. (There are some precautions that should be adhered to here, so when performing the task at hand ensure that you read the manual!)
4. Ignition offset adjust: this provides a method of setting the ignition timing when an offset is necessary. (This is also a very handy 'tweaking' function, as it provides an easy way to overcome any installation problems if a trigger plate is installed slightly out of sync.)

General Specifications...

Size (2D/3D ECU):	170 x 132 x 40 mm
Size (Hand Controller):	133 x 70 x 21 mm
Weight (2D ECU):	480 grams
Weight (3D ECU):	416 grams
Weight (Hand Controller)	346 grams
Power Supply:	6.5 to 23.5 Volts
Operating Temperature:	-40 to +85 deg. C
RPM map steps:	500rpm
Engine load map steps:	12.5% 3D (8 per rpm step) 2D (3 load bands)
RPM range:	0 to 12,000 rpm
Injector Drive Capacity:	up to 20 injectors (16 ohm) or 10 2.4 ohm injectors

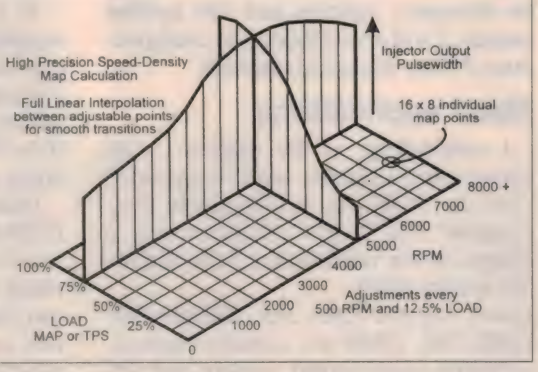


Fig.4: The general specification and fuel map representation for the Wolf 3D. The map relates rpm, load and injection time. In the specs, it can be seen that a Wolf 2D (injection only) system is also available.

Great flexibility

In previous articles we have covered OEM engine management systems, and it must be obvious that any engine management system needs certain input and output peripheral devices in order to be able to run the engine properly. Well, the Wolf 3D is no different in that respect it needs an input trigger, power supplies, load measuring devices, throttle position sensor, coolant temp sensor, injectors and so on.

What amazed me about the Wolf system was not just the simplicity of setting it up, but also its flexibility in terms of configuration. Apart from being able to drive multi-cylinder configurations (4, 6 and 8), it can be used as just an ordinary EFI system (i.e., fuel only, triggered from the negative side of the igniton coil) or it can be set up as a full-on engine management system with fuel and spark control with one coil and a distributor. It can even be used for multi-coil ignition (DFI ignition, one coil per cylinder, one coil per pair of cylinders) and also split-coil output for rotary systems. This covers just about all variations of ignition systems available!

MAP versus TPS

Another interesting feature of the system is the way that engine load is measured. There is an option of two methods: either the MAP (Manifold Absolute Pressure sensor) or TPS (Throttle Position Sensor) method.

The MAP sensor is mounted internally in the Wolf 3D unit and can be used to measure engine vacuum (load), so the ECM only needs to have a vacuum line attached to it. The MAP sensor is used to sense engine load when the engine is supercharged, turbo charged or when stable manifold vacuum is available. But this tends to become a problem when either very short or separate inlet manifold runners are used on the engine, or the engine has radical manifold variations due to a wildly modified camshaft.

In such cases the second option of determing engine load is then applied (TPS mode), and this is done by selecting an internal DIP switch function. See Fig.5 for the location of the DIP switches.

AEM recommends that if you do invoke the TPS load measuring mode, you should use a very good quality sensor. If you can't find one AEM or the Wolf 3D distributor can supply one. On the other hand if load is determined by the MAP sensor, then the original sensor for the TPS (if fitted) should suffice...

The other devices that are connected to the system to provide injection time variations are the coolant temperature sensor and the air temperature sensor. These sensors provide a trim for the injection time, as has been covered before in previous articles. A cold engine needs a richer mixture (carbies have a choke to provide this function), so the CTS reports engine temperature to the ECM and injection is then varied accordingly.

The air temperature relates to air density — i.e., the colder the air the more dense it is, and therefore the mixture (injection time) must again be trimmed to suit.

An oxygen sensor input is also provided and it gives an indication of the mixture feedback ratio, so a too rich or lean mixture can be identified and of course rectified. The system does not as yet provide closed-loop mode, but the next-generation units will include this function. At the moment even though it is only an indicator for the user to check on mixtures, it is very handy feedback because the mixture ratio can be continuously displayed on the hand controller — so if any problems do exist, they can be identified quickly.

The other main input is the trigger, and that will be covered next month because there are a few variations for triggering this system.

The outputs consist of fuel pump, fan control (both outputs are for relay control only and must not be connected directly to output devices, otherwise the ECM may be damaged), injectors and also ignition outputs. I will also elaborate on configuration of these outputs next month.

Many applications

I was talking to the guys at AEM about what vehicles have been fitted with the Wolf 3D, and basically their response was 'heaps!'. Here is only a sample of the vehicles that have had the 3D system fitted:

Piston engines: Chev 305; Windsor 289; GMH 308, GMH six cylinder (various, including supercharged version) and VN V6; Nissan FJ20, CA18; Isuzu Twincam; Toyota 4AGE, 3SGE, 3TGTEU.

Motor bikes: Honda CBX1000; Suzuki GSXR750; Kawasaki ZX9R; Yamaha TRX 850.

Rotary engines: Standard 12A, 13B; Extended Port 12A, 13B; Bridge Port 12A, 13B; Peripheral Port 12A, 13B; Turbo 12A, 13B.

The system also has the ability to load a map directly from a memory cartridge that plugs into the rear of the ECM (AEM have quite a library), so if you need a basic setup to get the engine running, a memory unit may be available for your particular application (or something very close to it). This provides a great way to get a 'dry' motor started and running, so that minor adjustment can be made to maximize performance.

The price of the Wolf 3D is $1395 and the manual, wiring, hand controller, memory cartridge and sensors are included in that price! As I said at the start of this article it's a very cost effective way to get enhanced performance — considering some 'hot chips' may set you back around $700 (not including installation and dyno time, so the kilowatts per dollar may not be as good as expected). Also it should be remembered that the performance enhancement achieved compared to a carby and points system is very significant.

Interstate supply and backup also doesn't seem to be a problem, because there is a national distributor network set up throughout Australia.

If you need any more information regarding the Wolf 3D system, then you can contact Steve or Marc at Advanced Engine Management. Their address is 22 Melrich Road, Bayswater 3153; phone (03) 9761 3161, fax (03) 9761 3162 or email marc@aema.com.au.

Incidentally AEM also has a fuel-only ECM known as the Wolf 2D, which as it states only does fuel injection. This has many of the 3D's programmable features and can be a very cost-effective proposition at $795, if the spark system on the vehicle provides adequate performance.

Well, that wraps it up for this month. We'll check out the rest of the system in part 2 next time. Until then, bye! ❖

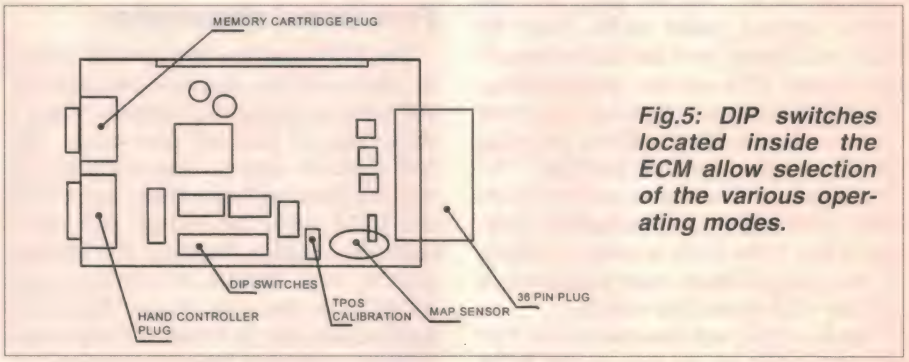


Fig.5: DIP switches located inside the ECM allow selection of the various operating modes.

SHORTWAVE LISTENING

with Arthur Cushen, MBE

Major changes at Radio Free Europe

A reduction in staff and a move from Munich to Prague have been undertaken by Radio Free Europe and Radio Liberty, as their role changes after 40 years of broadcasting to Eastern Europe. These stations played a major role in providing listeners in the former Soviet Union and its various satellite countries with news and information that were not available on domestic radio.

These stations had a special field of interest because Radio Free Europe covered all the countries of Europe, except the Soviet Union. It was the role of Radio Liberty to provide that area of the world with up to date information. Both were faced with severe jamming and had other problems in the transmission field, but with the ending of the Cold War, the stations now have a new role.

In an interview with the President of Radio Free Europe, Ian McFarland on a recent Radio Japan programme, listeners were told that the staff had been reduced from 1500 to 419 in a major budget cut. This has not reduced any services, as Prague is undertaking the same amount of broadcasting as was previously coming from Munich. This amounts to some 750 hours a week. The new group works on a budget of US$220 million.

Many of the employees did not want to move to the new headquarters and others found that the changing scene gave them an opportunity to seek other fields of employment. The Clinton administration agreed to a proposal from the Czech Republic to move to their capital, Prague, and the Congress ratified the proposed change. This has been a gradual move since 1994.

The changing role of the two networks has been from propaganda to more of an insight into the countries to which their broadcasts are directed. With major contacts in each region, this gives the broadcasters a new look to their programme service. The fact that Prague is the capital city is also an advantage, because many diplomats are stationed there, whereas Munich was not the capital of Germany and, of course, any diplomatic interviews had to be made in Cologne.

The broadcasts of Radio Free Europe and Radio Liberty are well received in this area. Although they do not carry transmissions in English, there are many who have come from Eastern Europe who can tune to their broadcasts and enjoy a high quality presentation of news from their home area.

BBC Thailand opens

The closure of the BBC relay base at Hong Kong and the move of the transmitters to Thailand is under way. When the two transmitters arrive they will add to the two 250kW units installed last year at the transmitting site, 12km north of Nakhon Sawan.

The first schedule issued for the new station indicates that they have taken over the existing Hong Kong schedule and frequencies. So there is no change as far as listeners are concerned, with the BBC signals from that area remaining as: 5965kHz 2100-2200, 2300-2400; 5990kHz 1300-1600; 6065kHz 0900-0915, 1100-1400; 9580kHz 0900-0915, 1100-1400; 11,955kHz 0330-0500; and 15,280kHz 0000-0030, 0100-0300 and 0330-0500.

The new site is aimed at improving audibility for more than 40% of the world's population. This new relay station is crucual to the BBC's broadcasting plans for Asia, and the agreement is designed to bring important benefits to Thailand. The US$18.7 million relay station with four 250kW transmitters will serve large parts of South Asia and China.

When fully operational it will carry BBC radio broadcasts in up to 10 languages including English, and reach potential radio listeners everywhere from Bombay to Beijing. As part of the overall agreement, BBC World Service is supplying a broadcast training package for the Public Relations Department and Radio Thailand. ❖

AROUND THE WORLD

AUSTRIA: ORF, Vienna broadcasts to Australia in English at 0830-0900, 1030-1100 on 17,870kHz, and to Asia at the same times on 15,240kHz.

CANADA: The English schedule of RCI, Montreal which we monitor is: 0200-0400 on 9755kHz; 0400-0429 on 9505, 9645kHz; 0600-0629 (Mon-Fri) on 6050, 6150, 9760 and 11,905kHz; 2100-2159 on 5925kHz, 9805, 11,945, 13,650, 13,690, 15,150 and 17,820kHz.

GUAM: KTWR's Pacific DX Report is now heard on 15,200kHz Tuesdays at 0900, a move from Saturday at 0815. The broadcast to the South Pacific remains Saturday 0940 at 11,830kHz.

IRELAND: West Coast Radio, Mayo is back on the air every Thursday as West Coast Radio Ireland, using a German Zulich transmitter at 0100-0200 on 5910kHz; 1500-1600 on 6015kHz; and 1800-1900 on 11,665kHz.

ISRAEL: IBA, Jerusalem's English schedule is 0500-0515 on 7465 and 9435kHz; 1500-1530 on 9390, 11,605kHz; 2000-2025 on 7465, 9365, 9465 and 15,640kHz.

JAPAN: Radio Japan in Tokyo's English Regional Service is from 0900-1000 on 11,850kHz, while the General Service is 0500-0600, 0700-0800 on 11,920kHz; 1900-2000 on 6035kHz; 0600-0800 on 11,850kHz; 1900-2000 on 7140kHz; and 2100-2200, 2300-2400 on 11,850kHz. The signals on 6035kHz and 11,920kHz are relays from Singapore.

NEDERLAND: Radio Nederland broadcasts to the Pacific 0730-0830 on 9720kHz (B), 11,895kHz (B); 0830-0930 on 5965kHz, 9830kHz (B), 13,700kHz; 0930-1030 on 5965, 7260, 9810 and 9830kHz (B). Here (B) indicates transmission from Bonaire; all other transmissions are from the CIS.

NEW ZEALAND: RNZI has advised frequency changes. Sign on at 1645 is now on 6070kHz, at 1745 they move to 9810kHz and at 1945 they move to 11,735kHz.

NORWAY: NRK, Oslo broadcasts 0600, 0700 on 7180kHz and 9590kHz to New Zealand; and 0900 on 13,800kHz, 1300 on 15,605kHz to Australia. English is on Sundays at 0600, 0900.

PHILIPPINES: PBS in Quezon City, Manilla broadcasts in English 0230-0330 on 15,120kHz and 15,270kHz with news in English at 0305.

RUSSIA: The Voice of Russia, Moscow opens at 0830 on 9810kHz with a new interval signal and theme, and no longer plays 'Midnight in Moscow' or the Kremlin Bells.

SEYCHELLES: FEBA should be heard opening at 0315, closing at 0415, in Swahili on 9820kHz with some interference from Cuba at 0400.

SOUTH AFRICA: Radio Nederland is using a Meyerton transmitter 1730-2025 on 11,655kHz, also on Madagascar relay on 6020 and 9605kHz. The BBC is to install four 100kW transmitters at Meyerton to replace those at Lancers Gap, Lesotho and will use the same frequencies: 0600-0800 on 6125kHz; 0800-1200 on 11,900kHz; and 1500-0600 on 3280kHz.

SWEDEN: Radio Sweden in Stockholm broadcasts in English to Australia 1330-1400 Saturdays on 7155, 13,740 and 15,240kHz; also 1430-1500 on 9435 and 9485kHz.

SWITZERLAND: SRI Berne's schedule to the Pacific is 0900-0930 on 9885, 12,075kHz and 13,685kHz; to the Far East 1100-1130 on 9885, 11,995 and 13,635kHz; and 1300-1330 on 7480kHz, being a relay from Beijing, China. ❖

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time and 13 hours behind New Zealand Daylight Time.

Practical workbench techniques:

BUILDING SUCCESSFUL 'RAT'S NESTS' - 1

Here is the first article in a short series, designed to provide newcomers with the background and construction techniques necessary to make quick 'lash ups' of all types of electronic circuits (especially video and RF). The secret of a good 'rat's nest' or 'lash up' is that it should not only be fast to assemble, but also sufficiently stable mechanically and electronically to prove that your design will work properly. In this series we'll show how to achieve this, using some sample projects to illustrate the techniques.

by ANDREW PIERSON

PC based circuit simulators notwithstanding, the time comes when most newly-designed circuits need to be tried out on the bench. It would be most unwise to rush into production with an untried design, particularly when radio frequencies are involved. For instance, a piece of wire which appears completely resistive on paper will have significant inductive and capacitive characteristics at very high frequencies.

It has often been said that the construction of RF circuits is 'part art and part science', as the way the circuit is laid out will affect its final performance. In addition to these considerations, the circuit may not work in the manner you predicted. After 'playing around' with a circuit configuration for a while, it may become obvious that it is not going to fulfill your expectations, and that particular approach may need to be abandoned. It's far better to find this out at an early stage of development, before a great deal of time and money has been expended in making a 'final version' which has to be thrown away!

The object of a successful 'lash up', 'rat's nest' or whatever else you want to call it, is to produce a working test circuit in the minimum amount of time, but which has sufficient electrical and mechanical stability to prove that the circuit will work to its design specification.

Most of the rules for making good 'rat's nests' which are presented in these articles also apply to the final product, whether it uses printed circuit or hard wired construction. There are areas where the disciplines of design and construction overlap. Examples of this are seen in the effective bypassing of supply rails, and also the measures necessary against unwanted feedback and parasitic oscillations.

Various approaches

Whilst 'plug-in' breadboards have been popular for digital prototypes for many years, they are not generally suitable for linear high frequency work — because of the way they are manufactured, which involves lots of stray inductance and capacitance. 'Veroboard' and other strip systems generally suffer from similar problems.

Another 'lash up' technique involving PC board which was used in the past involved having one side of a PC card etched to form a large number of small, individually insulated 'islands'. These were used as terminations for the components, which were mounted on the track side, and interwiring was carried out by means of hookup wire links. Variants of this are currently available, where each 'island' or 'pad' is drilled with one or four holes and the components are mounted on the reverse side. Unless the layout has been very carefully thought out, the inductance of the necessary interwiring would prove troublesome at very high frequencies.

These widely available and inexpensive metal baking trays make ideal chassis for experimental (and permanent) 'rat's nests'. I'll spare you any weak puns about 'cooking up' a circuit!

The object of obtaining the best high frequency performance is achieved by having component leads as short as possible, with a minimum amount of interwiring, correct layout and effective shielding. This equates to keeping stray inductance, stray capacitance and unwanted feedback as low as possible.

Ground planes

The most successful high frequency prototyping systems use the *ground plane* technique. For our purposes, a ground plane may be loosely defined as 'a very low impedance, earthed surface which, by being placed in close proximity to the circuit, provides convenient earth points for circuit components and shielding in the direction of the ground plane'.

After the development of radio passed out of the insulated 'breadboard' stage, the steel and aluminium chassis which were then used were, in effect, the first ground planes.

For many years, most wideband circuit prototypes have been built using a piece of un-etched PC board laminate as a ground plane. If additional shielding was required, extra pieces of PC board were then added around the sides and at the top, to form a completely enclosed and shielded box. Also, pieces of PC board were used inside the box for shielding one circuit section from another.

The problem with this method is that hobbyist constructors or small firms without the luxury of a guillotine would find the task of cutting the necessary pieces of PC board onerous.

Now, let me introduce you to an inexpensive alternative: the wide range of 'Willow' brand tin plated steel baking trays, available from the kitchenware department of your local supermarket,

etc. These are very cheap (much cheaper than PC board) and provide a rigid chassis with a highly solderable surface which doesn't oxidize and show fingerprints like the copper on PC board.

Since these trays are made of steel which has a higher resistance than copper or aluminium, they would be more susceptible to problems from induced earth currents (this will be discussed in a later article); but they are suitable for the vast majority of applications. Also, I can't vouch for the performance of this material at ultra high frequencies, particularly if any significant levels of power are involved.

The trays can be used either upturned, or can have the circuitry built down inside the tray area. If necessary, another identical tray can be placed (upturned) on top, thus completely shielding the circuitry inside. For those trays having flanges, this area can be drilled to take the bolts which will hold the top and bottom halves together. Internal shields can be made from tinplate or unetched PC board. For semi-permanent 'rat's nests', the sides of deeper trays can be drilled to take sockets, switches etc.

Having chosen our chassis material, how do we start laying out a prototype circuit? Firstly, some planning will be required. For example, we will need to estimate how large the circuit will grow, and choose an appropriately sized chassis. We will also need a rough idea of the proposed layout, so that inputs and outputs can be intelligently placed.

Unwanted feedback

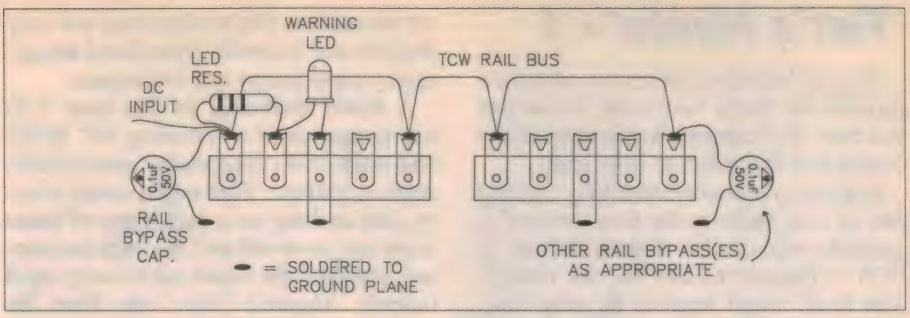
You have probably heard the cynical statement that 'amplifiers usually oscillate and oscillators usually only amplify' — referring to unstable RF amplifiers and oscillators with insufficient feedback. An oscillator is produced by deliberately introducing sufficient positive feedback to a circuit with gain (an amplifier).

On the other hand, a circuit designed only to amplify may oscillate because there is an unintentional feedback path present. Usually, this is due to poor layout, but occasionally even the best layout won't solve the problem, and deliberate negative feedback (neutralization) has to be added to the design.

When constructing a rough prototype, the last thing that we want is to introduce unwanted feedback into a circuit which possesses gain, so there is a basic rule which it is always wise to follow:

To minimize capacitive coupling, keep the input(s) as far away from the output(s) as possible.

This usually means building the circuit in a straight line. You can probably see



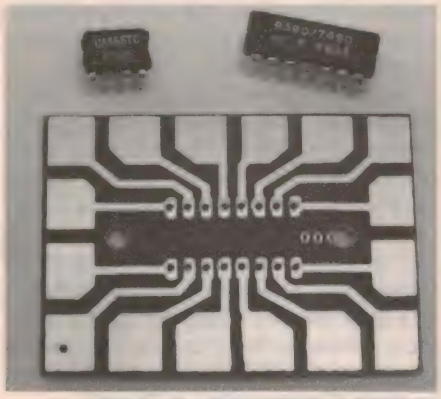


Fig.1 (top): this arrangement will provide a good starting point for your 'rat's nest'. Note the rail bypass capacitors and the LED circuitry to warn you that power is applied to the circuit.
Left: This type of utility PC card allows you to incorporate IC's into your 'rat's nest'. Their size may be trimmed down, if necessary.

that it would be a mistake to fold the circuit path around into a 'U' shape, where the output was brought back in close proximity to the input. Remember that it's not just the input and output *leads* that can be capacitively coupled, but also all the *components* attached to these leads.

Spreading the circuit out over a greater distance will increase the separation between the input and output leads, but if the feedback is occurring around the active device itself (the transistor or integrated circuit), this won't be of much help. Also, a circuit which covers a larger area will have increased stray inductance and capacitance. At ultra high frequencies, a physically large circuit may also have problems due to standing waves.

Physical separation can be of assistance where tuned circuits exhibit unwanted coupling, or alternatively a screen can be installed between them. Feedback can also come from several other sources, e.g. via the supply rail, or even via common earth paths. We'll discuss these later, in another article.

Screening

In a multi-stage RF amplifier, it may be necessary to build each stage in a separate screened compartment. Whether this will be necessary or not will depend on the gain and bandwidth of each stage, the frequencies involved, coil orientation and how compactly the circuit is built.

Deciding upon the amount of screening is often a matter of trying out what you think is a sensible layout and subsequently adding screens, if necessary. Note that a 'sensible layout' includes leaving adequate space for the possible installation of screens, if you run into trouble. Remember that a screen which is too close to a tuned circuit will act like a shorted turn and thereby reduce its quality factor or 'Q'.

Quite apart from the prevention of feedback, another function of screening is to prevent leakage of undesirable signals (crosstalk) from one part of the circuitry to another.

When a top screening cover is fitted over RF circuits, it may change the stray capacitances and affect tuning. Therefore, any alignment should be carried out with the cover in place. This means that you'll need to drill access holes in the correct positions for slugs, trimmers and trimpots, etc. Use only non-metallic tools for alignment, to avoid changes in the inductance of coils and capacitive effects on trimmers (not to mention shorting trimmers and trimpots to the earthed cover!).

Soldering techniques

The fact that what you are building is 'just a lash up' is no excuse for poor soldering. A 'dry joint' is mechanically and electrically unreliable, and may lead to false conclusions about the performance of the circuit under evaluation.

To successfully master the method of construction to be described, you will need to be familiar with two types of soldering. The first is 'tack' soldering, where a minimum of heat and solder is applied, to temporarily hold one end of a component in place until the other end is secured.

Once all the leads forming a particular joint are in place, the joint is then 'fillet' soldered by quickly bringing the joint to temperature and applying just sufficient solder to form neat fillets with all the leads involved. If you apply heat for too long and/or apply too much solder, the joint will run (particulary if the leads are vertically orientated).

'Rat's Nests' - 1

As your lash-up circuit grows, it pays to periodically check back over the section you have just completed and convert any overlooked tack joints to fillet joints.

Keeping component leads long 'so they can be used again in the final version' is generally unwise. For a start, the use of PCB techniques means that the component leads won't need to be very long, anyway. Also, it is a good policy to use all *new* components in the final PCB version, as the use of completely different components may give you an insight into possible reproducibility problems.

I keep 'lash up' components separate, and use them only for that purpose. If you use secondhand components, you also run the risk of introducing latent mechanical and thermal defects, brought about by the components' past history.

Putting it together

Now that you've got a broad understanding of some of the obvious traps which can be present in high frequency circuit layout, we'll discuss the best (and quickest!) way to connect the circuit components together. The first things that you'll need are a good supply of tagstrips of varying sizes. I find that the five-lug (with the earth lug in the centre and two lugs either side) 'large' (10mm pitch) tagstrips are generally the most useful. You'll also need some 22SWG (0.71mm) tinned copper wire (TCW) for supply rail busses and interconnections.

The old concept of using tagstrips or tagboards was that the ends of all components had to reside in a tag somewhere. As well as being expensive (tagstrips aren't cheap, although they are re-usable), this method was not very flexible and it usually introduced unnecessary capacitance and inductance.

A better technique in this case is to use a tagstrip as a 'jumping off' point, and make most component interconnections in mid-air. This might sound flimsy, but as long as a minimum of three leads are involved and the joint is properly soldered the result can be very rigid indeed. Tagstrip lugs can then be reserved for input and output connections, and the odd joint which mightn't otherwise be as secure as you'd like.

To start the building process, solder down your first tagstrip direct to the chassis. The first necessity for any electronic circuit is a power source, so the supply rail (or rails) are your first priority. They should be securely anchored and properly bypassed (this important subject will be discussed in more detail in a later article). I find that an arrangement similar to that shown in Fig.1 is the most versatile if there are a considerable number of connections to the rail.

With this arrangement, you have continuous access to the power rail bus, and plenty of spare lugs available for circuit terminations. Note the warning LED and its associated feed resistor. Prototyping involves frequent switching on and off of the power supply, interspersed with soldering operations. One day you're going to get 'out of sync' and blow something. The illuminated LED simply reminds you that power is applied to the circuit. When the 'fiddling' phase is over, the LED and its feed resistor can be removed; this has been done in all the photographs.

If you require a second (usually negative) rail, the arrangement shown in Fig.1 (minus the LED circuitry) may be duplicated parallel to, and some distance away from, the first rail. If you're not sure how much space your circuitry will occupy, start building away from the first rail and install the second rail when you've gained an appreciation of the separation needed.

There are some instances where the above rail distribution method isn't appropriate. If most of the circuit subsections are fed from their own decoupling networks, it is better to mount the decoupling components on individual tagstrips and link these by running the rail using insulated hookup wire. An example of this technique will be shown in a later article, when we look at a small VHF FM transmitter lash-up. Also, where high voltages are involved, insulated rails should be used (see the section on 'High Voltage Safety').

Mounting IC's

Probably the most useful accessory for incorporating IC's into your 'rat's nest' is the small 16-pin DIL PC card which is available from several sources (see photograph). After you have mounted the IC on the card, mark the pin numbers AND the IC type number on the track side. Mount the card with the track side uppermost, and sufficiently far above the chassis so that if you need to replace the IC you can solder-suck the pins and drop the IC out from below.

Although these cards have two mounting holes, it is usually not necessary to make use of them. The board will generally be held rigidly enough in the first instance by means of the supply rail and earth connections (made using TCW) and also any rail bypass capacitor(s). All the extra connections which will then subsequently be required will help to make the assembly quite strong. When 6-pin, 8-pin or 14-pin IC's are fitted into these 16-pin cards, the extra pads will then be available for circuit interconnections or ground anchor points. Try not to build components over the IC pins, as this will make removal of the IC much more difficult.

The solder pads provided on these cards are quite large, and for certain critical applications they may introduce too much capacitance and inductance; or the whole card may simply increase the area of the circuit by an unacceptable amount. In these cases, part or all of the pads may be removed beforehand with a small hacksaw.

RF coils

RF coils should be mounted rigidly, to avoid unwanted changes in inductance and capacitance. Whilst this may not be significant in a wideband circuit like a

A simple example of the kind of 'rat's nest' prototype construction advocated by the author. This circuit, for a wideband video amplifier, will be described in more detail in the second of these articles.

video IF stage, it may be the source of unwanted microphonic effects if, for instance, the coil is part of a frequency modulated oscillator.

When choosing the wire gauge for an air wound inductor, the rigidity of the finished coil must be considered. A very rigid coil is usually preferable, but you may need to use thinner wire if the coil is to be 'knifed' during alignment. This involves spreading out the turns of the coil to lower its inductance, and is generally performed as part of a 'once-only' alignment procedure after manufacture.

When casting around for a mandrel on which to wind a coil, don't overlook the shanks of the drill bits in your tool kit! Of course, they should be in good condition — as burrs, etc. might damage the enamel insulation on the wire. Alternatively, pieces of wooden dowelling of various sizes can be used.

When right angle bends are required at the ends of coils, make the bends whilst the coil is on the mandrel, as this will prevent the coil from becoming deformed. Also, you can use the mandrel to keep coils which have separate windings accurately aligned whilst they are being soldered into position.

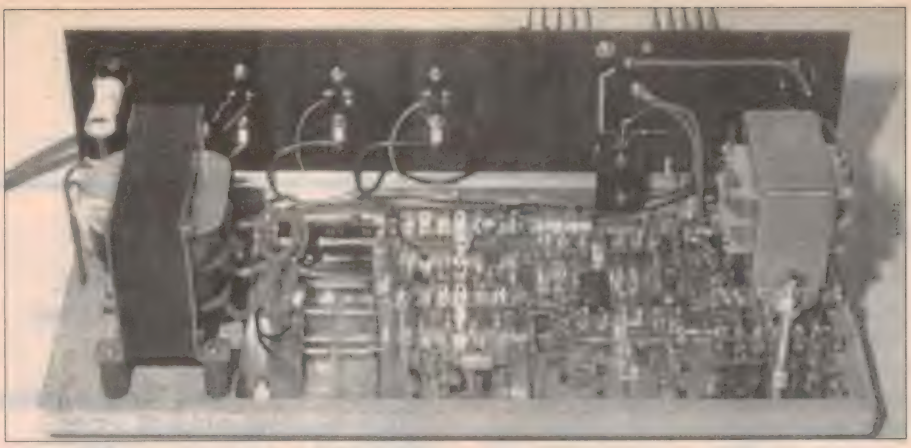
Remember that the leads of components connected to a coil effectively become part of that coil. This effect is most significant when the coil inductance is small — i.e., when the circuit is operating in the VHF or UHF region. So, the rule is: keep the connecting component leads short!

A grid-dip or gate-dip oscillator (GDO) can be a valuable tool for determining the resonant frequency of a tuned circuit *in situ*. (The GDO and other test instruments will be covered in a later article.)

Coils wound on formers and intended to be fitted with a shield can in the final version should also have the can fitted *and earthed to the ground plane* in the 'lash-up', so that the capacitive and shielding effects will be the same. The earth connection should be kept short (depending upon the operating frequency) to avoid introducing unwanted inductance.

Coil cans are usually best mounted vertically, with the pins uppermost. Small pieces of double-sided adhesive foam mounting tape will be found useful for this, but don't use too large an area as the can may be difficult to remove if subsequent changes are required.

When winding RF transformers, it is normal practice to arrange for the 'cold' ends of the primary and secondary windings (the ends with the lowest RF impedance to earth) to lie together. If possible, the primary and secondary should also be wound *away* from each other to reduce capacitive coupling between the 'hot' ends of each winding. Overwinding or interwinding can give tighter magnetic coupling, but it increases the capacitance between the windings. An example of an RF transformer for VHF can be seen in the photograph of an FM transmitter, in one of the later articles.



A high power 'rat's nest' built by the author, for an inverter. The heavy transformers and the circuit itself (made on blank PC board) are all mounted on a piece of particle board, with the power transistors being mounted on the vertical panel at the rear. The unit operates from a 240V, 50Hz supply and delivers a voltage regulated 117V, 60Hz output which is phase locked to the 50Hz supply mains. It was used for driving 60Hz clock motors.

Other components

The method of mounting small transistors, resistors, capacitors and other two-leaded devices will be clear from the constructional examples to be given. Unless the 'lash up' is going to be a semi-permanent affair with a front panel, trimpots will generally be used in lieu of panel-mount potentiometers.

All adjustable components like trimpots and trimmers should be firmly mounted on tagstrips, so that the surrounding circuitry is not disturbed when they are adjusted. It's useful to note that the two outer legs of large (10mm) vertical-mount trimpots fit nicely onto adjacent lugs of the 'large' size tagstrips, leaving the wiper leg in the centre. If a trimpot is going to be used for a 'once-only' adjustment (e.g., for setting bias level, etc.), it may be permissible to mount it less securely, like a resistor.

When wiring trimpots, try to develop the habit of orientating them so that the wiper rotation corresponds to the direction shown on the circuit diagram. I know that this is not always feasible, but it will make the adjustment procedure a lot more logical. Similarly, try to mount components so that their values can be read easily. Again, you won't be able to arrange this every time, but it will make subsequent circuit drawing and the noting of design revisions easier.

Trimmer capacitors should be 'polarised' so that the adjustment shaft is earthed if possible, or at least connected to the lower impedance side of the circuit. Also, don't forget to angle the slots or shafts of adjustable components so that you can get to them with the appropriate tools!

Power transistors and regulators with small heatsinks may be mounted directly onto tagstrips, but bigger heatsinks will need to be mounted separately. A few small pieces of double-sided adhesive foam mounting tape will stop the heatsink from moving around, and will also insulate it from the chassis. However, a better procedure is to fit the power transistor with the appropriate insulation kit. This will isolate the heatsink electrically and reduce the possibility of a catastrophe, should something touch the heatsink or short it to earth.

Front panel parts

As the circuit is only a 'lash up', you'll be anxious to avoid the elaboration of a front panel, if at all possible. Since meters are relatively expensive items and will probably be re-used, their installation should be left until as late as possible, to avoid their plastic faces being marked by the odd spot of flying solder or flux. Generally they can be placed at some distance from the circuit, provided that the leads to any meters involved in measuring RF are properly bypassed within the circuit. The same comments apply to potentiometers controlling the voltage to varactor tuning systems.

In the second of these articles, we'll look at power supplies and safety, and then show how the techniques we've discussed are put into practice, with a simple project example.

(*To be continued*) ❖

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INFORMATION CENTRE

by PETER PHILLIPS

Project ethics, space travel and DX reception

Our first topic is about responsible and irresponsible project builders, and whether we should take a different attitude in deciding the types of projects we publish. We also look at balanced transmission lines, present details of an anti-gravity aircraft, look further at AM DX reception and introduce a computer game.

I'm starting immediately with this letter, which is about the alcohol breath tester project in the October '96 issue.

Thank you for an interesting, if misinformed project. From the 'been there and done that' perspective I feel obliged to tell you that the device as presented is positively dangerous — it may allow a marginal testee to assume an ability to safely drive a vehicle. Would you let your daughter get into a car with that driver?

You may not be aware that some drivers actually make less mistakes with a BAC (blood alcohol concentration) of up to 0.12% (averaged over hundreds of individual tests). This is in part a psychological phenomena. Apart from this, even very experienced and fit racing car drivers make silly and elementary mistakes when 'over the limit' — in the laboratory naturally. Let me add that getting some famous faces scientifically drunk (discreetly of course) was a fun thing to do.

You seem unaware that the sensor was originally designed about 18 years ago for air conditioning system monitoring. Honda have an existing patent for an ignition-prevention system using a similar concept. I've also designed bilge fume detector/control systems using this device. (Incredibly there are still people who take petrol to sea!)

In the interest of supplying a breath tester with a degree of accuracy and consistency — something that this project is just not capable of — I am prepared to detail the methodology of the gear I designed and patented some 15 years ago. I'm not interested in any remuneration, I only want to save people killing or seriously injuring themselves, and others. Perhaps you might like to put a whole new project together. In the interim please confirm my opinion of this project with the Police. I have yet to see approval of this type of tester anywhere in the world.

May I assure you that getting the bodies out of the wreckage is no fun at all. The vehicles aren't much good afterwards either. Keep up the high standard we've come to expect. (Peter Lucock, Wynnum West, Qld)

I've presented this letter first as it deals with two interesting topics. The first is the assumption Peter makes about readers of the magazine. The second is the device itself.

I wonder how many readers share Peter's opinion that publishing an article describing a breath tester is an unsafe, and therefore an irresponsible thing to do. If you are one of these, ask yourself whether you'd use the device to check *your* BAC, and if the instrument registers a bit less than the legal limit, subsequently drive a car. Of course you wouldn't, I hear you say. You wouldn't rely on such a device for something as important as that!

Now ask yourself if you know of anyone with the intelligence to build and calibrate the device, who would. Certainly there are people who make assumptions that if it's electronic, it's got to be accurate and reliable. However I doubt if these people are regular readers of *EA* and with the skills needed to build and calibrate such a device.

But, perhaps someone might build this unit and, after showing it off to family and friends, lets it fall into the hands of a young driver who thinks it's a good way to legally drink and drive. Again I wonder if we are making assumptions, this time about the apparent stupidity of young people. My son, who is as silly and irresponsible as any 20-year-old, wasn't even interested in the tester. Nor were his friends, who are all given to the occasional binge. Their strategy is simple: get a non-drinker to drive.

I believe most people are more responsible than some of us give credit for, particularly about drink driving. I'll probably get a few letters supporting Peter's view, with examples to illustrate, but I suspect many people will agree with me.

For this reason we don't want to assume the role of 'big brother' about projects, despite the possibility (which we believe is remote) that some people who build or use a project might do the wrong thing and get themselves or others killed. As far as I know there's not much evidence to say that magazine projects of any type have resulted in any deaths. And when you think about it, we and most electronic magazines have produced a wide range of potentially dangerous projects. After all, any project that operates from 240V is a hazard.

Now let's look at the 'misinformed' project. As the author of the article, I can talk with some authority on the project and the content of the article. And yes, Peter, I did go to the police to seek opinions and to get information. The view expressed by the officer who showed me how police breath testers are calibrated was quite favourable, providing I made the point in the article that the instrument is only as good as its calibration. And that appears in the introduction to the article, and many times throughout.

There's even a warning box at the end of the article that repeats this message. And at no point in the article is there any suggestion that the tester is 'approved'. Of course it's not, any more than a police roadside breath tester is. The only approved device is the expensive instrument at the police station, a point I believe I made clear in the article.

The calibration techniques are described as being a guide only, and throughout the article, readers are reminded of this. Anyone building the tester would soon realise that its accuracy is related directly to its calibration, which, as explained in the article is

something most people cannot do to a high degree of accuracy. In fact, there's so many reminders of the accuracy-calibration relationship in the article, that I wondered if I'd overstated the case.

So what *can* it be used for, if it's not good enough to accurately measure your BAC? Here's an example, that occurred a few weeks ago when I attended a male only 'beer testing' night, organised by a neighbour. It was a social gathering for those who lived nearby, and was an excellent excuse for me to meet my new neighbours, as I've only recently moved to the area. I was older than most of those present, whose average age was 30-something.

As the evening wore on, everyone's blood alcohol content increased substantially, so I decided to bring out the breath tester. As I'd guessed, everyone, according to the tester, was well over the limit. True, I'd tweaked the setting a bit to make sure it read on the high side; but my point is, it gave us all a way of relating how we felt compared to our BAC reading. I'm sure everyone went away remembering this, and hopefully I've been responsible for making one of two of them realise how easy it is to exceed the BAC limit.

As for the design of the project, I can't see that it matters whether the sensor has other uses, or that it's 18 years old. Its use here is no doubt one of many, and if it has been around that long, then perhaps we can assume it's a reliable sensor.

You also mention Peter that you'd be happy to provide details of a more reliable and accurate tester. We'd be delighted to see your design, and if you truly have a breath tester that needs little or no regular calibration, we'd be pleased to describe it. But such a device does seems unlikely, as even the best breath testing instruments need regular calibration (monthly or less). So given that calibration is everything, the best design in the world does not mean best accuracy. Would you let *your* daughter ride in a car driven by someone whose BAC registered just under the limit on your tester? I wonder...

However Peter, I do want to thank you for your letter. You've written to us in the honest belief that, based on your experiences, our project could be dangerous. You have presented your views with authority, humour and with an obvious concern for others. While I don't agree with you, I've presented your letter first in this column in the hope it will serve as the basis of discussion among readers. A delicate subject, but one I'm glad to air.

Transmission lines

In September 96 I included a letter from a reader about balanced transmission lines. The letter contained an extract from the 1994 *ARRL Antenna Handbook*, describing a way of making a shielded, balanced transmission line. As shown in Fig.1(a), this can be done with two lengths of conventional coaxial cable. The following letter raises more questions, based on audio cables:

My understanding of a balanced transmission line is that it consists of two conductors, with each driven in opposite phase to the other, and both run together in the same electromagnetic shield, to enable proper common mode rejection. This requires that if a line is to be shielded, the shield must be around both conductors, with the conductors lightly twisted together to maximise uniformity of exposure.

This is evident in my field of experience with 100V PA systems, and microphone cabling in buildings. If conventional figure-8 shielded cable (like your Fig.1a) is used as a reasonably long microphone line, noise pickup is far greater compared to using proper microphone cable (Fig.1b). We come across this many times when investigating troublesome and noisy installations done by amateurs or other organisations.

The correct term for this type of transmission should, in my opinion, be differential transmission. A lot of car audio gear is going this way now, and is using the same misnomer (balanced) to promote it.

A classic case of a balanced communications line is the twisted copper pair telephone line to your house. This goes long distances without shielding, mixed with other similarly balanced lines, with minimum noise pickup, relying on good differential drive and good common mode rejection provided by transformer or electronic balancing at the other end, and a slow twist in the pair over its length.

Nit picking, you might say? I merely bring it up because personal experience has shown that the two methods are not directly interchangeable, with noise cancelling effects that are wildly different. Proper balancing is very effective, whether at RF or AF, differential mode rather less so. (Joseph White, Kojonup WA)

When it comes to audio frequencies Joseph, I totally agree with you. I used to do this sort of installation, and always used the twin, twisted shielded cable you refer to. As you say, it gives better results as far as noise cancelling is concerned, providing the amplifying equipment is properly designed.

But I'm not sure if this also applies to radio frequencies. While a twisted pair with a common shield will give the best common mode rejection, this construction would give an unpredictable characteristic impedance for the cable. This is not as important for audio, but it's critical for RF. As well, because of the high frequencies involved, capacitive coupling between the intertwined cables would result in considerable losses due to signal cancelling.

Normally, an RF balanced transmission line is not shielded, as in TV ribbon. And as any antenna installer will tell you, it's common practice to lightly twist the ribbon for best noise rejection. This type of transmission line, given good quality ribbon and a reasonable signal strength, is often less lossy than unbalanced coax, although more prone to noise pickup. Perhaps other readers might like to comment.

Anti-gravity airship

I was going to leave the anti-gravity question rest, but the following is so interesting I think you'll forgive me for continuing this topic. It was sent by Syd Cladingboel, of Redhill in SA, who downloaded it from packet radio some

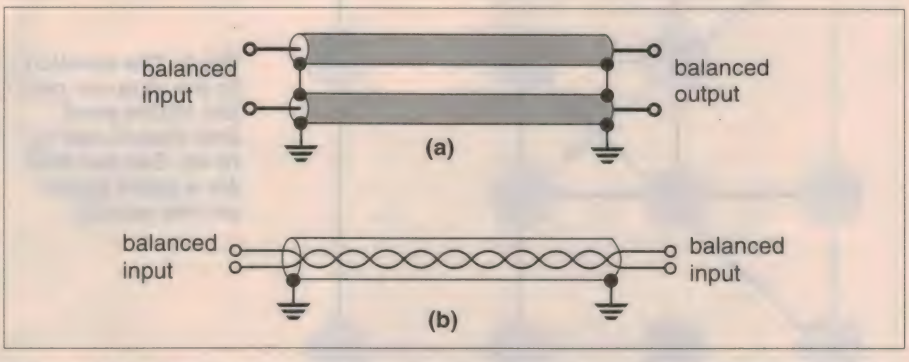


Fig.1: (a) A balanced transmission line made from two separate coax cables. (b) A balanced shielded cable used in audio work.

time ago and gives the physical details of a so-called anti-gravity aircraft. Maybe someone might have the resources to actually build it. If so, can I invite myself and Wayne Shirley for a ride?

I've included the entire article Syd sent me, so if you have any questions about the article, I probably can't answer them. You'll notice too that I've converted the imperial measurements to metric, but have left the original imperial measurements in case my conversions are incorrect. So see what you think of this:

One of Joseph Newman's ongoing interests is in the field of gravity, with reference to electromagnetic air/space vehicles. A news clipping of this presentation before the southern MENSA Society Convention in Mobile is featured in his book 'The Energy Machine of Joseph Newman'. The following is an affidavit prepared on this subject by Dr Roger Hastings:

I have witnessed a demonstration of Joseph Newman's electromagnetic air and space vehicle prototype. It consists of an aluminised helium balloon wrapped with #38 gauge copper wire. The system is nominally heavier than air. When the wire coil is connected to a 200 volt battery, the balloon gradually lifts into the air. It aligns with the Earth's magnetic field as it rises. If the current is cut off, the balloon immediately begins to fall. If the current direction is reversed, the balloon rotates to align with the Earth's field.

The balloon can be made to rotate or oscillate by manipulating the direction of current flow. If the current is periodically switched so that the balloon always repels the Earth's field, its rate of ascent is about 25% faster than the case of steady attraction of the coils to the Earth's field.

Newman's design calls for the creation of a magnetic field which is on average about equal to the Earth's field over the volume of the balloon. This can be achieved with minimum input power using a large number of turns of fine wire. I have considered vehicle modules with the following properties:

Volume = 10 x 10 x 10 feet = 1,000 cubic feet (3.05 x 3.05 x 3.05m = 28.37 cu m); helium lift = 70lbs (31.78kg); wire = 12,000 turns of #38 AWG copper; wire weight = 23lbs (10.4kg); battery = 3,000 volts DC; battery weight = 15lbs (6.8kg); material weight = 10lbs (4.54kg); payload weight = 22lbs (10kg); DC current = 10mA.

A vehicle which is 100 feet (30.4m) in diameter and 50 feet high (15.2m) would consist of 400 of the above cubes and would carry a payload of 4.4 tons (4.5 tonnes). A vehicle which is 1000 feet (304m) in diameter and 500 feet (152m) high would consist of 400,000 of these cubes and carry a payload of 4400 tons.

The following points should be noted: (1) The total payload is proportional to vehicle volume. (2) The electromagnetic torque and lift are also proportional to volume in this design. (3) Navigation is achieved by manipulating the orientation of the coils. (4) If superconducting wires become available, the batteries will not be required. (5) For improved efficiency with copper wiring, sets of the cubes can be connected in series and energised with pulsed high voltage. Newman has developed such techniques to extend battery life.

(6) In the atmosphere, lift is provided by a combination of ohmic heating of the helium gas, electromagnetic interaction of the helium atoms with the applied fields, and interaction of the applied magnetic field with the Earth's magnetic field.

(7) It is intended that the craft can operate entirely through interaction with the Earth's magnetic field once it leaves the atmosphere. This interaction will be especially strong in the ionosphere and persists in the Earth's magneto tail. Newman's invention was designed and disclosed in a patent application prior to its construction. It represents a vastly improved means for propulsion and navigation of helium balloons (blimps). Larger versions may well carry us gently and safely into space. Dr Roger Hastings, Ph.D. [Signed and notarised]

This appears to be a craft based on magnetism, not anti-gravity. However Dr Hastings suggests the craft will fly into space where, presumably, the coils will still provide enough reaction against any existing magnetic fields to cause motion.

Incidentally, we've read further reports in *New Scientist* about the anti-gravity discovery I presented in December. It appears the discovery will *not* be presented in the *Journal of Physics-D: Applied Physics*. Two of the three people involved have disassociated themselves from the discovery and the third has been made a financial offer from an unnamed organisation. Part of the deal apparently is keeping the details of the discovery a secret. Interesting, I'm sure you'll agree.

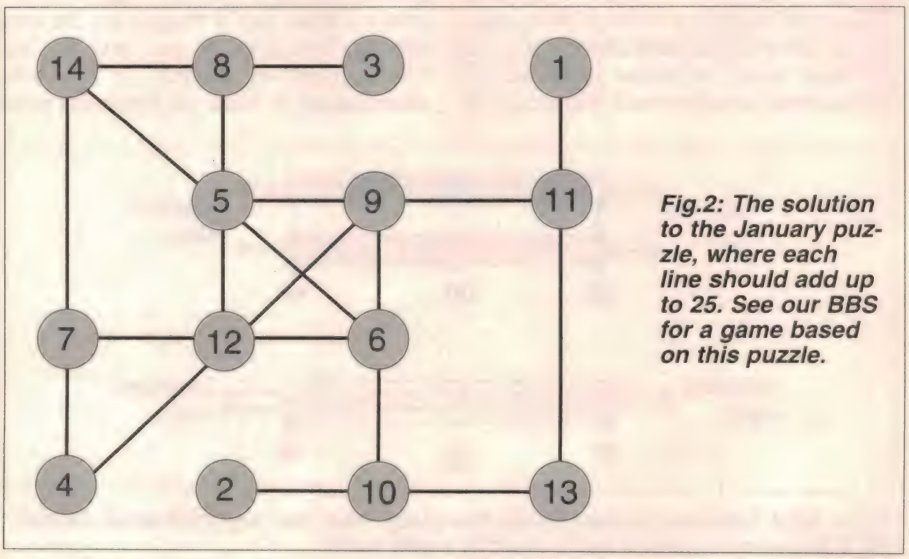


Fig.2: The solution to the January puzzle, where each line should add up to 25. See our BBS for a game based on this puzzle.

AM antenna

Going on kit sales, it appears that one of our more popular projects in recent times has been the Miracle AM Antenna, presented in the November '96 issue. The following letter adds an interesting finding by a reader, who although not using the aforementioned antenna, has an external DX antenna looped to the receiver's non-tunable loopstick aerial, in a similar way to the Miracle antenna:

My present AM antenna is a V-shaped pair of 30m long wires about 6m above ground. The wires converge at the south of the house, and feed a co-axial cable that runs to the receiver, which is located on the north wall, about 3m from the incoming power lines. A dedicated earth is used for the coax. Reception using the

loopstick by itself is hopelessly noisy, as my house is aluminium clad and roofed. When the external antenna is added, the reception is considerably cleaner, as you'd expect.

Now for the interesting bit. When the external antenna is connected, as I move the loopstick in azimuth with the external antenna, there is a change in the relative noise volume. In fact it's possible to achieve an almost perfect noise null (once in 360°, not 180°), which I interpret as a phase reversal of the strong noise + weak RF signal present inside the house cancelling the noise component of the strong RF signal + weak noise signal from the external antenna.

Incidentally, do you have any information on tuning a long-wire antenna? Such things were commonplace once, and ideal for us 'out of town' folks who often listen to one or two AM stations only. (Ron Voller, St Georges Basin, NSW)

Ron also offered to send me a demo audio cassette to illustrate his finding. Obviously some sort of cancelling is occurring, but this would mean the noise signal from each antenna must be the same. Whether this will work in all cases is difficult to say, but it's sure worth a try. So if you've built the Miracle antenna, and you are getting noise in the reception, try playing around with the relative orientation of the receiver's loopstick antenna. Or, of course, move the antenna to a location away from the noise. Thanks for the idea, Ron.

Regarding tuning a long wire AM antenna, as far as I know this is best achieved by making the length of the antenna a submultiple of the wavelength of the signal you want to receive. Typical submultiples for TV aerials are one half and one quarter, but using a quarter wavelength and the equation for wavelength of 3 x 10^{10} cm/s divided by the required frequency, gives for a frequency of 1MHz, a wire length of 750m. So I guess there has to be another way. Perhaps readers can advise, as I could find no reference to this sort of antenna in my books.

Star puzzle game

Last month I described a software game based on the Linden Beswick star puzzle, developed by 'The Guys' from Esperance Communications, Esperance WA. At the time I had not heard back from them following my request to put the game on our BBS. Since then, not only have The Guys given us permission to put it on our BBS, they have also added another game to the program. This one is based on the more complex puzzle I included in January, where all lines have to add up to 25.

The files for both of these games are all zipped together into a single file called TEASERS.ZIP, and it is on our BBS ready for you to download. The file can be found in the Useful Utilities area (area #110), or use the Instant Download option from the main menu. The program runs under Windows 95, and Windows 3.11. Once decompressed, installation is simply a matter of running the setup program. If you get the error message "Warning - cannot copy file a:\ddeml.dl_ since the destination file is already in use", just ignore it and hit the Enter key so that the installation can continue.

You might like to use the game called 25 to see if you can find another solution to the puzzle I gave last month. The solution shown in Fig.2 is the one provided by the contributor (Kim Nelson, Greenfield Park, NSW), but there are probably others.

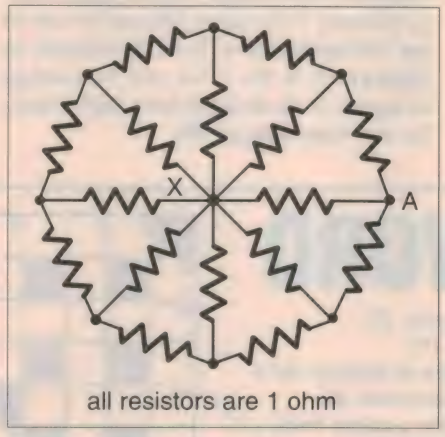


Fig.3: Find the resistance between points X and A...

Thank you Colin (who I think did a lot of the work on the program), Alex and Lorna. Colin's email address is included in the read.me file if you want more information, or if you find any bugs in the program. As far as I can tell, the program works perfectly, and I have installed it on several computers.

Scope downconverter

The next letter is from a reader who admits he is very new to electronics:

I recently purchased a 20MHz scope, but apparently for some VCRs you need a 30MHz scope. I've read in a book on CB radios about a device called a scope extender, which down-converts signals from 50MHz so they can be viewed on a scope with a bandwidth as low as 5MHz. In the States, a similar device, model HFX-1 costs around $70. Have you ever heard of such a device and are they available here?

Also, are there any videos that show how to repair a VCR. All the books I've read are out of my depth. (H. Chandler, Ashford NSW)

The book you refer to Mr Chandler is probably describing a down converter for an RF carrier. This is a common use for such a device, where the carrier frequency is changed to a lower value, while still retaining the modulation information (the signal being carried by the RF carrier). Certainly a down converter would allow a high frequency carrier to be viewed on a low bandwidth scope, where you will see the modulation of the carrier. But as a general tool, it has no other application other than with a frequency counter, where the input signal is divided by 10 or 100 before being applied to the counter.

Regarding VCRs, there is no simple way to learn about their innermost workings. TAFE run a one year course on VCR repair, but only for those with prior education in electronics and TV. You are dealing with a complex device, and if the truth be known, most VCR faults are mechanical anyway. Here you need to understand how the transport system works, how it's aligned and so on. As well, you need a good range of spares, mainly belts. I suggest you start with something simpler and work up to VCR repair.

What??

This month's question is pure electrical theory. It was sent to me by Charlie Worsfold, along with a few more questions I'll present in future editions. The problem is rather similar to the October '92 What?? question, and uses a similar cartwheel resistive network except this one has 16 resistors, compared to the previous 12 (Fig.3). The question is: what is the resistance between the centre node (point X) and any other node, say node A. It can be done with simple equations, by the way.

Answer to January's What??

The answer is three. By taking three resistors, you must get at least two that are of the same value. If these are 5Ω resistors, connect them in series to get a 10Ω value. If you get two 20Ω resistors, connect them in parallel. Similar to the drawer full of black and white socks, where a random grab of three will always result in a pair the same colour. ❖

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Here we feature some items from past issues.

February 1947

US Television Costs Increase: Television receiver costs are likely to be considerably higher than previously estimated, the *New York Herald-Tribune* reports. Present indications are that prices will be roughly one-third to one-quarter higher than originally expected. With installation and guarantee costs added, the advance becomes even more impressive.

This would place some of the lowest-cost sets close to $300. Many of these, it was indicated, will include only television sight and sound, with standard frequency modulation broadcasting reserved for the high-priced models.

Atomic Energy: Professor M.L. Oliphant, Australian-born leader of research in nuclear physics, now in Australia, is quoted as saying that if atomic energy is made the object of an arms race, it would not be possible to harness it for peacetime purposes.

The Professor here has raised a most important point. It is obvious that if atomic energy and its method of production are to be made the items of power politics, the world of commerce has very little chance of being enlightened on developments and uses of it.

February 1972

Lithium high-energy cells: High energy primary cells using lithium for one of the electrodes have been developed by Honeywell in the USA and Matsushita in Japan. Both designs have high capacity and long storage life.

Honeywell is marketing in volume quantities a cell, designated G2600-B, which is 25.4mm in diameter and 35.6mm long, with a weight of 26.2g. Nominal voltage is 3.2V compared with all-mercury batteries of similar size, which produce about 1.2V.

Matsushita has developed four prototype models which it plans to market in Japan this year. Working voltage is 2.6V per cell and energy density is 4 to 5 times (in some cases 10 times) higher than conventional cells.

Satellite broadcasting: A direct satellite-to-receiver telecast is scheduled to occur in mid-1973 in the Rocky Mountains area of the USA. Educational television programs will be transmitted to 500 community receivers in schools, public broadcast stations, cable systems and other locations. After a year's use over the Rockies, the satellite is scheduled to be moved into stationary orbit over India, for direct broadcasting of educational material to community TV sets there.

Researchers at Stanford University, California, have developed a simple S-band earth station for receiving satellite TV pictures that they claim will sell for about $170 including a 7ft aerial dish, in 1000-unit quantities. ❖

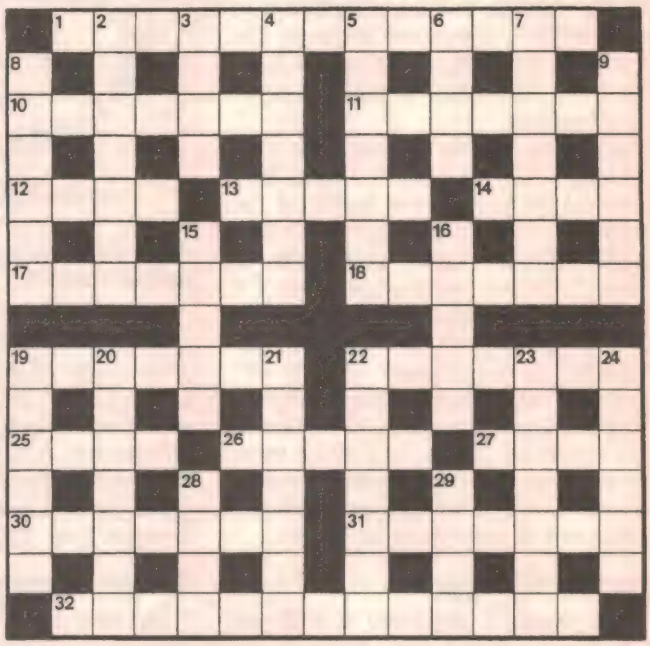
EA CROSSWORD

ACROSS

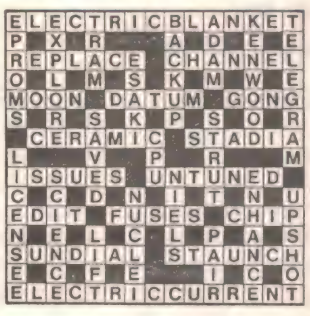
1 Type of battery. (6-7)
10 Set of instructions. (7)
11 Said of office-type hardware. (7)
12 Non-SI unit of energy (abbr). (4)
13 Substance made in electric arc furnace. (5)
14 Flat storage medium. (4)
17 Student. (7)
18 Initiating device. (7)
19 Again bring rays
22 Flow. (7)
25 Amount of ionising radiation absorbed. (4)
26 Produce a colour finish. (5)
27 Visible fault in TV picture. (4)
30 Pressed for fastening. (7)
31 Optics of a simple magnifier. (3,4)
32 Factor in which NiMH batteries excel, compared to 1 across. (6,7)

DOWN

2 Line on a chart joining points of equal wind speed. (7)
3 Type of cell with optic properties. (4)
4 Device that controls maximum output. (7)
5 Location of specific data.(7)
6 Support for antenna. (4)
7 Eliminate a tangle or kink. (7)
8 Sharp impulses. (6)
9 A hard disc that is not magnetic! (6)
15 Operate a mouse. (5)
16 Television pioneer. (5)
19 Attenuate. (6)
20 Disintegration of nuclei. (7)
21 Mode of readiness. (5-2)
22 Control panel. (7)
23 Part of an array. (7)
24 Force. (6)
28 Crystalline mineral. (4)
29 Radio receivers were once called wireless ——. (4) ❖



SOLUTION TO JANUARY 1997:



NEW BOOKS

SSB communications

SINGLE SIDEBAND SYSTEMS & CIRCUITS, by William E. Sabin and Edgar O. Schoenike. Second edition, published by McGraw-Hill, 1995. Hard cover, 236 x 156mm, 652 pages. ISBN 0-07-912038-5. RRP $190.

The second edition, much updated, of a well respected handbook on just about every aspect of SSB transmission, reception and equipment design. The first edition of 1987 was itself a replacement for an earlier volume published in 1964, and co-editor Edgar Schoenike has been involved in all three editions. Essentially they've all been the work of engineers at what was originally Collins Radio Company (nowadays the Collins Division of Rockwell International Corp.), which has always been closely involved with the development of SSB communications.

There are now chapters on HF link establishment and digital signal processing, as well as discussion of new and currently topical areas such as the use of power MOSFETs in power amplifier design, computer simulation and systems analysis, pilot carrier SSB, direct conversion, the combination of digital and analog circuitry and electromagnetic compatibility. There's also a 3.5" floppy disk with shareware programs to assist in the design of filters, SPICE component modelling, PLL design and so on.

The coverage is thorough and concise, being written specifically for SSB equipment designers — both professionals and advanced amateurs. There are many diagrams and graphs, plus all of the basic maths. Each chapter also ends with a detailed list of references, for those wanting to go deeper.

An excellent reference on SSB communications systems and their design, from the experts at Collins/Rockwell.

The review copy came from McGraw-Hill Australia, at 4 Barcoo Street, Roseville 2069. (J.R.)

Chip testing

PRINCIPLES OF SEMICONDUCTOR NETWORK TESTING, by Amir Afshar. Published by Butterworth Heinemann, 1995. Hard cover, 160 x 242mm, 213 pages. ISBN 0-7506-9472-6. RRP $125.

This book is aimed primarily at those involved in microcircuit test and measurement, and contains eight chapters in which digital, analog and mixed-signal testing procedures are explained. The first two chapters cover diode and transistor operation and include a brief description of the semiconductor manufacturing process from silicon ore to processed wafer and implanted microcircuits. Also explained are methods of testing a die on a wafer, along with an explanation of the wafer test hardware, aimed at test and product engineers.

The chapter on noise identification covers methods of identifying noise, along with practical suggestions for suppressing it. In another chapter, digital signal processing is discussed, a new and developing field with its own particular testing needs. The mathematical level, though not complex by some standards, covers Fourier series and transforms, with low level calculus thrown in.

The remaining chapters provide descriptions of analog and digital devices, including data acquisition devices and operational amplifiers, along with their testing procedures. The author says the tests can be used in a laboratory or they can serve as a guide for writing test programs for automated test jigs.

The book is well illustrated and the writing style is easy to read.

The review copy came from Butterworth Heinemann, PO Box 146, Port Melbourne 3207. (P.P.)

GPS directory

DICK SMITH'S AUSTRALIAN GPS LOCATION GUIDE, by Dick Smith. Published by Dick Smith Adventure, 1996. Soft cover, 212 x 149mm, 160 pages. ISBN 0-9586934-0-4. RRP $14.50 plus $2.00 P&P.

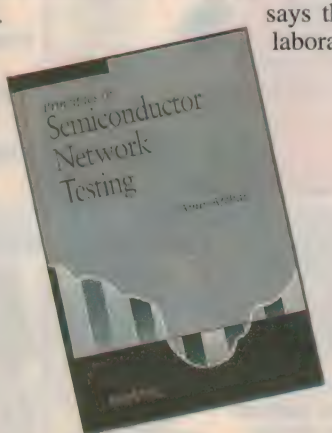
The satellite-based Global Positioning System is great for travellers of almost every kind — especially now that handheld GPS receivers are available for as little as $500 or so. You can determine where you are, virtually anywhere on the Earth's surface, to within about 100m and with a direct readout in degrees of latitude and longitude. But how far is it from where you are *now*, to where you *want* to be? And exactly which direction is it in? These details are often more important than your current location, and to work them out, you need to know the co-ordinates of wherever it is you're try to get to.

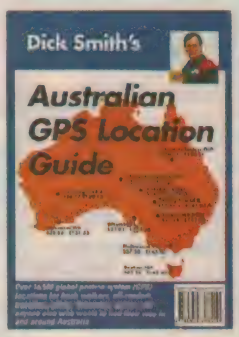
That's exactly where this new book by my sometime-boss Dick Smith comes in — at least for people travelling within and around Australia. Essentially it's a listing of some 16,500 locations of interest around the country, giving the latitude and longitude figures for each.

There are actually three separate listings, each giving locations in alphabetical order. The first lists all of the aerodromes in Australia; the second lists 'Interesting and famous places, including outback routes, locations of important signposts and wells'; and the main listing covers 'Towns, Cities and Other Locations'. There's even a page which readers can photocopy and fill in their own suggested additions, for faxing back to Dick for use in the next edition.

All in all it's a very practical little book, which will no doubt find its way into many glove boxes.

Copies are available from Dick Smith Electronics or Australian Geographic stores, or directly from Dick Smith Adventure at PO Box 418, Terrey Hills 2084; fax (02) 9486 3482. (J.R.) ❖





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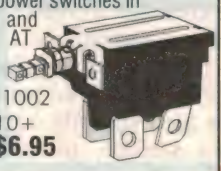

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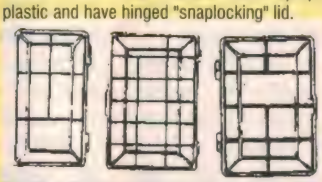

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Cat No. U22188 1-9 $23.95 10+ $21.95

SUPER CAPACITOR

FARAD 5.5V

R15620

$6.95

EPROMS

STOCK UP WHILE THEY ARE CHEAP!

Cat No.	EPROM	1-9	10+
U20592	27C64	$8.95	$7.95
U20593	27C128	$7.95	$7.95
U20594	27C256	$8.95	$7.95
U20595	27C512	$8.95	$7.95

TRANSISTORS

		1-9	10+
T90746	2N6125	$1.90	$1.50
T90763	C3460	$14.95	$12.95

100mA CQY89 INFRARED RED DIODE

Z10172

$1.95

CLEANING PAD FOR COMPUTER SCREEN/ KEYBOARD/ PRINTER

Remove dirt, smoke particles, dust from screens, printers, keyboards.

C21084

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PACK OF 40

IC EXTRACTOR

HORSESHOE TYPE

T12185 $2.95

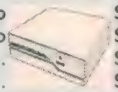
CPU EXTRACTOR

Changing CPU over in a breeze with this extractor. Save your CPU from damage!

T12181 $6.95

GENUINE INTEL TOOL, DESIGNED FOR CERAMIC CPUS.

SWITCH BOXES- HUGE RANGE!!



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Centronic 2 way Auto	$39.95
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(Chocolate block)

Now you rewire anything from a telephone or intercom system to an 80 amp Solar Array. They are so reasonably priced you can afford to keep a couple of each in your tool box. Come in and see our huge range.

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P18055	30 amp - cable entry 5.6mm	$1.95	$1.70
P18057	60 amp - cable entry 7.0mm	$2.95	$2.20
P18059	80 amp - cable entry 7.0mm	$3.95	$3.00

KEYBOARD/MONITOR WIPES

Remove dirt, smoke particles, dust from screens, printers, keyboards and general surfaces.

C21300 $5.95 PKT 10

C21301 $8.95 PKT 20

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ESTABLISHED SINCE 1977

A.C.N. 005 428 437

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KTX 33.6K HIGH SPEED FAX MODEM

The KTX 33.6K external fax modem connect at speeds higher than 33600 bps with other V.34+ enhanced modems.

X19045 $189

FEATURES:

Compatibility Supports the following communications standards:
•V.34+ (33600 bps) •V.34 (28800 bps) •V.32bis (14400 bps) •V.32 (9600 bps) •V.22bis (2400 bps) •V.22 (1200 bps) •Bell 212A (1200 bps) •Bell 103 (300 bps) •V.17 (14400 bps FAX) •V.29 (9600 bps) •V.27ter (4800 bps FAX) •V.21 (300 bps FAX Channel -2) •V.42 bis (data compression) •V.42 (error correction) •MNP 5 (data compression) •MNP 2-4 (error correction)

Control & Operation •Auto-dial and Auto-answer operation •Automatic Fall-forward/Fall-back •Automatic feature negotiation •Automatic speed buffering •Automatic speed negotiation •Call progress monitoring •Class 1 and Class 2 FAX command sets •Digital and Analog loopback tests •Extended AT command set •Hardware or software flow control •Non-volatile memory (stores 2 modem configurations and 4 phone numbers) •Security- Callback with password checking option •Software adjustable speaker volume •115,200 bps DTE speed support

Contents •User manual •Telephone cable •Com port cable •Power adaptor •BitWare™ F/D sofware & manual •Windows 95 Plug & Play driver disk

KTX 33.6K VOICE FAX MODEM

X19046 $249

This KTX external Voice Fax Modem allows advanced voice function which includes:

•Recording* and playback of voice via software (effectively this model can function as an answering machine, mail box centre or as a tele-marketing system).

•Advanced FAX functions allowing this model to send and receive fax up to 14400 bps transmission rate with Group 3 fax machines.

•Communications features same as above model

•Contents same as KTX 33.6K FAX MODEM except for Cheyenne BitWare™ VFD Voice/ Fax/Data software for Windows

V.34+

*It is illegal to record "live" conversation between telephone users.

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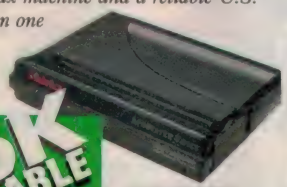
Puts the convenience of an answering machine, a speakerphone, a fax machine and a reliable U.S. Robotics modem in one compact unit. Upgradable to 56.6K speed!



56.6K UPGRADABLE LOGON TO rie.net.au for full details.

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50 FREE INTERNET HOURS*

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11 pieces service kit for servicing and repair of computer, printed circuit boards, peripherals and all types of electronic equipments.

- 1 Nutdriver: 1/4"
- 1 Nutdriver: 3/16"
- 1- IC Extractor
- 1 Tweezer
- 1- FlatScrewdriver, 1/8"
- 1- FlatScrewdriver, 3/16""
- 1- Philips Screwdriver, #1
- 1- Philips Screwdriver, #0
- 1- Torque Screwdriver: T10, T15
- 1-Three Claws Parts Retriever/ Extractor
- 1- IC Insertor, 14-16 Pin ICs

T12452 $29.95

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These great EPSON printers now comes with bonus software to help you create and print colourful greeting cards, flyers, sign.., business presentations, etc. Software include: •Sierra Print Artist for Windows V3.0 •Adobe PhotoDeluxe for Windows V1.0 •Adobe PhotoDeluxe for Macintosh V1.0 and Some "Fun" fonts and "Fab" photos. Also for a limited time PhotoPlus for Windows will be included.

EPSON STYLUS™ 200

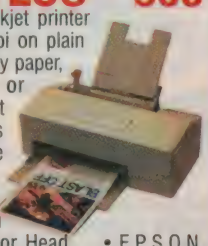
•High resolution 720 x 360 dpi • Photo-quality output •Improved output on plain paper stock •Interchangeable colour printhead and monochrome printhead •Ink cartridges included •EPSON unique microweave technology for smooth halftones and elimination of "banding" •New formula ink for vivid colours •400 A4 sheet feeder •Unique Windows™ printer drivers for easy setup and superb colour reproduction

C92300..Tax Ex $333 $399

PHOTO QUALITY COLOUR

EPSON STYLUS™ 500

Photo-quality full colour inkjet printer •64-nozzle •720 x 720 dpi on plain paper, special coated, glossy paper, transparency film or envelopes •Maximum print speed at LQ20 cpi/ 400cps • Bitmap LQ & Scalable fonts included •100 sheets plain paper tray •Up to 3pmm A4 black/ 1.5ppm in colour •Multi-layer Actuator Head • EPSON ESC/P2 & IBM® X 24E control codes •Centronic® type 8-bit parallel interface (IEEE-1284 nibble mode)/ Macintosh® serial interface (RS-422) •Microsoft® Windows® version 3.1x



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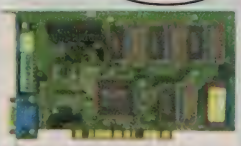
FOR OUTRAGEOUSLY FAST GRAPHIC!

NEW DIAMOND STEALTH 3D VIRGE VIDEO CARD

X18218 $199

This new addition to the Stealth family will speed up the graphics, video and overall performance of your PC. Stealth 3D is packed with features and outperform similar class of video cards available in the market. It uses the latest in video display technology -the S3 VIRGE Chipset. •3D hardware acceleration •2MB EDO DRAM upgradeable to 4MB •PCI 2.1 compliant • **OEM Pack with software driver disk only.** *Logon to rie.net.au for full WinBench® 96 comparision and monitor frequencies info.*



SPECIFICATIONS:

Controller:	•S3 Virge Chipset •64 bit
Bus Type:	•PCI 2.1 compliant
Memory:	•2 MB EDO DRAM Upgradeable to 4MB
Horizontal Sync Signals:	•31.5KHz- 81.5KHz
Vertical Refresh:	•43.5Hz - 120Hz
Maximum Dot Rate:	•135MHz
Connectors:	•DB-15 with DDC support •VESA 26-pin header

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PENTIUM 100MHz.	$249
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PENTIUM 133MHz...	$399
PENTIUM 150MHz.	$569
PENTIUM 166MHz.	$749

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CPU	CPU ONLY	M.B. INCL.
150MHz	NA	$999
180MHz	$899	$1599
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X18165	16bit ETHERNET RJ45 + BNC	$49
X18169	16bit NE2000+	$119
X15810	Ethernet 5-port 10 base T hub	$169
X15814	Ethernet HUB 10 base T Connector (8 RJ45 Effective)	$199
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X18190	Printer 2-Port Slct Lpt 1-2 Card	$39
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C14260	SMART GAMES Cont	$39.95
X18514	FULL -DUPLEX ISA **ETHERNET**	$99
X18171	Ethernet **Intel PnP** BNC/RJ45 16-bit	$199
	*Ethernet **III Rev B Coax (BNC, AUI)**	$250
X17396	OEM SBlaster PnP Vibra 16 with IDE interface	$109
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X17398	OEM SBlaster PnP Vibra 32 Sound Card	$189
X17357	OEM PhoneBlaster	$289
X17250	ESS 16 Bit Sound Card	$55

SB OEM products do not have manual or connection cables

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X18195	VESA VGA CARD	$149
	PCI	
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X18206	PCI VGA DIAMOND STEALTH 1MEG DRAM	$109
X18207	PCI VGA DIAMOND STEALTH 2MEG DRAM	$139
X18208	PCI VGA DIAMOND STEALTH 2MEG VRAM	$399
X18209	PCI VGA DIAMOND STEALTH 4MEG VRAM	$799
X18218	**New** OEM PCI Diamond Stealth 3D Video 2MEG	$199
X18183	PCI VGA CIRRUS LOGIC 5430 1MEG	$75
X18195	PCI VGA 64-BIT CIRRUS LOGIC 5436	$199
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X18214	PCI MGA MILLENNIUM 4MB WRAM	$595
X18216	PCI MGA MILLENNIUM 8MB WRAM	$995
X18150	PCI Ethernet BNC/RJ45	$79
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K10045	ETI 480 100W AMP	$34.95
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K10060	BALANCED MICROPHONE AMPLIFIER	$12.95
K10070	BALANCED INPUT DIFFERENTIAL PREAMP	$19.95
K10075	FLOAT NICAD CHARGER	$14.95
K10080	TRANSISTOR TESTER	$22.95
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*AVAILABLE SOON

NEW KITS NEW KITS NEW KITS NEW KITS NEW KITS NEW KITS

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K10810 $59.95

Making use of a new Hall effect sensor available from Fastron technologies, this simple project enables you to take mains current measurements of up to 10 amps in complete safety, with readings accurate to 1%. Due to the high bandwidth of the sensor used, you can also use your scope to examine and measure any waveform components from DC up to 25kHz- again in complete safety. ***EA Nov '96***

A POCKET SIZED "MINIOSC" AUDIO OSCILLATOR

ALL NEW!

K10805 $45.25

NO PICTURE AVAILABLE AT TIME OF PUBLICATION

Here's a high performance audio oscillator design that is small enough to fit literally in a shirt pocket. Despite its size, it produces low distortion sine or square wave at any frequency from 41Hz to 18kHz, and runs from a standard 9V battery. ***EA DEC '96***

HIGH PERFORMANCE PLAYMASTER PREAMP

ALL NEW!

K10815 $291.95

NO PICTURE AVAILABLE AT TIME OF PUBLICATION

SHORT FORM K10816 $188.95

The Playmaster Pro Series range of high-quality hi fi gear- the Pro Series Four reference premap. Developed from the respected Pro Series Two control preamp, this new design offers a larger number of features including infrared *remote volume control*, an even simpler construction method, and as before, first-class performance. ***EA DEC '96***

PC-DRIVEN ARBITRARY & FUNCTION GENERATOR

ALL NEW!

K10820 $162.25

Need to generate signals with special formwaves, for testing? Here's the design for a PC-driven unit that will cost you much less than commercial function of arbitrary waveform generators, but can produce signals of virtually any desired waveform at frequencies from 0.25Hz to beyond 100kHz. ***EA DEC '96***

Video Transmitter and Receiver

K10795 *Transmitter* $68.45

ALL NEW!

Now you can send video signals over a long distance using twisted pair cable. Use this Transmitter and Video Receiver to wire your home or business with a remote video outlet for entertainment or security. ***SC Oct '96***

K10796 *Receiver* $70.95

BUILD A VGA DIGITAL OSCILLOSCOPE

SC AUG '96 K10790 $269.95

One of the real attractions of this digital scope, based on a VGA monitor, is that you don't have to peer at the display- it is large, bright and the different coloured traces and graticule make it easy to interpret what's happening.

LOW COST POCKET SAMPLER

K10780 $32.95

ALL NEW!

EA AUG '96

This compact PC-driven analog sampler requires no batteries or power supplies. It uses power from the PC, supplied to it via the parallel port. It allows you to monitor voltage changes over periods ranging from milliseconds to months.

INFRA-RED STEREO AUDIO LINK

K10800 $130.45

Our new Infra-red stereo link allows you to relax in your favourite armchair and listen to stereo sound at a level that suits you. Individual volume controls allow you set the left to right balance. ***SC Sept '96***

SMART DUAL 12V BATTERY CONTROLLER

K10740 $49.95

This auxillary battery manager takes full advantage of a dual battery setup's capabilities, by controlling when and how the "auxillary" battery is connected to the electrical system. It's fully automatic, will cost you far less than an equivalent commercial unit, and is particularly suited to the new breed of deep-cycle auxillary batteries. **EA JAN'96**

PC DRIVEN EGO SENSOR ANALYSER

K10735 $39.45

With car engine management systems becoming more and more sophisticated (and complex), it is getting increasingly difficult to find out what's happening "under the hood". This low cost analyser, combined with any IBM PC and some special software can provide a large amount of information on your car's performance. ***EA JAN'96***

LOW COST RF TEST OSCILLATOR

K10755 $139

A low cost RF oscillator design that is suitable for checking and aligning HF radios and other equipment operating between 350kHz and 30MHz. Features digital frequency readout, the ability to provide either CW or modulated output and also audio and 1 MHz reference signals from auxiliary outputs at the rear. **EA May '96**

PC- DRIVEN ELECTROCARDIOGRAM

K10680 $29.95

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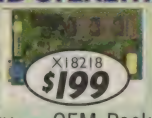

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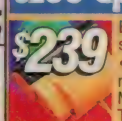

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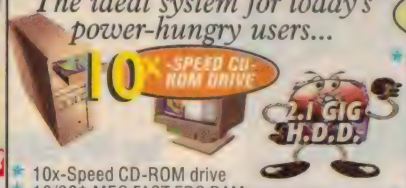

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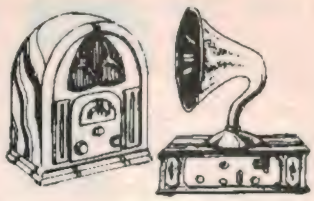

One-Valve Receivers (1): from 1916 to 1926

One might think that the humble one-valve radio was so simple that there would not be much to discuss. However, reference to the resource material has yielded so much information that to tell the story properly will take two articles. Here's the first episode, where we look at the designs and models that appeared before 1927.

In the early and middle 1920s, when it was realised by all and sundry that radio or 'wireless' was here to stay, a one-valve receiver was seriously considered as a budget priced alternative to a multi-valve, loudspeaker radio. Remember too, that for a 'skilled worker', five pounds per week ($10) was considered quite a good wage at the time, and that even a one-valver could cost up to three weeks wages when batteries and earphones were included.

The one-valver was popular, too, with home constructors. For the extra price of a valve and batteries, two or three fixed components and an perhaps an extra tuning capacitor, the crystal set could be 'upgraded' (to use modern parlance!) to a much much better receiver.

Where it all began: WW1

Although the triode had become established by World War 1, it was still in the realms of a piece of laboratory apparatus; hand made, expensive, fragile and none too reliable. But as WW1 progressed, the military chiefs realised the importance of radio in particular for the artillery observers to reliably report upon their fall of shot. (WW1 was largely an artillery war. Entire woods, forests and farm lands were laid to waste by incessant artillery bombardment.)

The French wireless engineers developed what has become known as the 'R' type valve, sometimes called the 'French valve', which was quite superior to practically anything else, mainly because of its ruggedness and reliability. It is interesting to note that the base connections of the 'R' type became the standard base connections for what is known today the 'European 4-pin' or 'British 4-pin' triode.

1916 then is a useful starting date to talk about triodes and one-valver radios for what eventually became domestic use.

In these early sets it is not uncommon to see the valve being used purely as a diode detector. Military radio collectors will know that the 'Mark III' tuner, made between 1916 to 1918 in large numbers, was a very elaborate and well designed crystal set, in which the operator could switch from a galena diode detector to a biased carborundum detector. There was provision for a valve to be connected externally as a signal diode detector. This provision was to enable the operator to obtain the most reliable and audible signal.

The other use to which the early valves were put was as an add-on audio amplifier for a crystal set.

The 'wireless receiving apparatus' of those early days were totally reliant for their selectivity and sensitivity upon the quality of the tuned circuits (i.e., their freedom from losses), and the efficiency of the antenna system. Circumstances would arise where the detected audio signal would be barely audible, if at all, in the headphones. Hence the need for an audio amplifier.

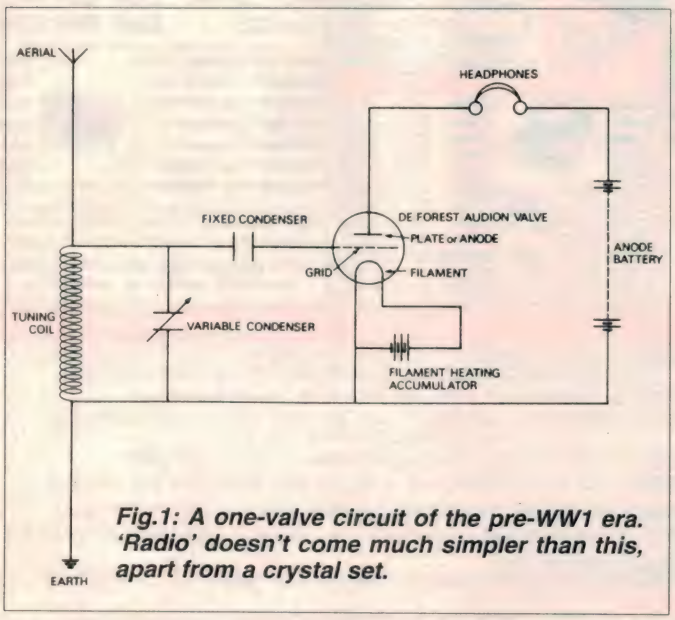

Fig.1: A one-valve circuit of the pre-WW1 era. 'Radio' doesn't come much simpler than this, apart from a crystal set.

The earliest valve sets

Fig.1 is representative of a very early one-valve receiver, dating from perhaps before WW1; as such it is beyond the reach of the majority of collectors. Such a receiver would be a very poor performer by today's standards. Firstly, there is no means of coupling the antenna to the tuning circuit.

It must be remembered that around 1912 there would have been very few stations on the air. There were certainly no broadcast stations as we know them. The signals would have consisted of long wave spark transmissions of Morse code in the 1000m to 3000m wavelength (300kHz to 100kHz) band. The rudimentary long wire antennae may have assisted in providing some sort of antenna tuning to increase selectivity, if required.

Note the apparent absence of a 'grid leak' resistor. In the absence of a grid leak, the electrons travelling from cathode to anode accumulate upon the grid element and build up enough electrostatic charge to bias the valve almost to cut-off. Also, there is no provision for the grid capacitor to slowly discharge, thereby affording 'demodulation' or detection.

Fig.3: Unusual for the USA is this advertisement for a commercially made one-valver, from the September 1924 issue of 'Radio News'.

However, in fairness, demodulation was not an issue for receiving spark transmission. As long as the headphones produced some sort of audible buzz which could be recognised by the operator as Morse code, the reciver had done its job!

In reality there would have been a 'grid leak' in Fig.1, consisting of the losses occurring across the somewhat imperfect grid capacitor. Seldom were those capacitors properly hermitically sealed (or electronically tested!), and there was enough leakage — of even, say, 10 megohms — to provide a high value resistance path from grid to earth. So the grid leak is actually there! Of course as technology progressed, it did not take engineers long to work out that a separate grid leak resistor provided more reliable results.

The grid leak detector

The grid leak detector, or 'leaky-grid' detector as it became known, did two jobs in one. Firstly, the grid and cathode elements of the valve itself become the two electrodes of a diode. This, in combination with the grid capacitor and the grid leak resistor, enables detection or demodulation of the incoming signal. The resulting audio signal across the grid leak is negative with respect to earth, and the valve now acts as an audio amplifier with a fluctuating audio negative voltage impressed upon the grid.

RF potentials are also present at the anode, and once they have passed through a reaction winding, if present, are bypassed to earth via a capacitor connected between B+ and earth.

The other important aspect of the leaky grid detector is that the impedance of the diode load circuit, which for practical purposes is the value of the grid leak resistor itself, is high. The load impedance of say, 5 megohms, could be a factor of 10 higher than that of a lump of galena and steel wire used as a signal diode, feeding directly into headphones. This results in an increase in selectivity.

Something else, too, that the valve detector afforded was the elimination of the so-called 'step voltage' necessary to activate the semiconductor effect of the lump of galena. Put another way, there must be a certain potential, albeit small, to turn the crystal 'on', and as a result a certain small voltage is lost across the device.

Hence, the leaky grid one-valve detector provided an important step in the progress of radio reception. It provided for both greater selectivity and greater sensitivity.

Armstrong and Reinartz

The remarkable Major Edwin Armstrong is regarded as the inventor of regeneration, or 'the reaction circuit', with which many readers may be familiar. Basically, a small portion of the amplified RF signal is coupled back to the tuning coil. If the signal is correctly in phase with the incoming RF signal, the gain of the amplifier is increased and also the 'Q' of the tuned circuit is greatly enhanced, providing even greater selectivity. Of course if too much RF is fed back the valve will oscillate, which is why the reaction or regeneration control must be carefully adjusted for each signal frequency.

An American experimenter, Reinartz, published a very selective circuit based upon the Armstrong regeneration principle in the July 1922 edition of *QST*, the monthly publication of the American Radio Relay League. The circuit, which

Fig.4: A lineup of the valves which heralded the broadcast era. Left to right are (1) the box for (2) the new Marconi type V24; (3) Airforce type 'C' attributed to Captain Mullard; (4) the Philips type 'E'; (5) the Marconi type '5RV' with BBC emblem: (6) the Philips type 'DII'; and (7) a very early Radiotron type UV-200. All valves are in perfect working order!

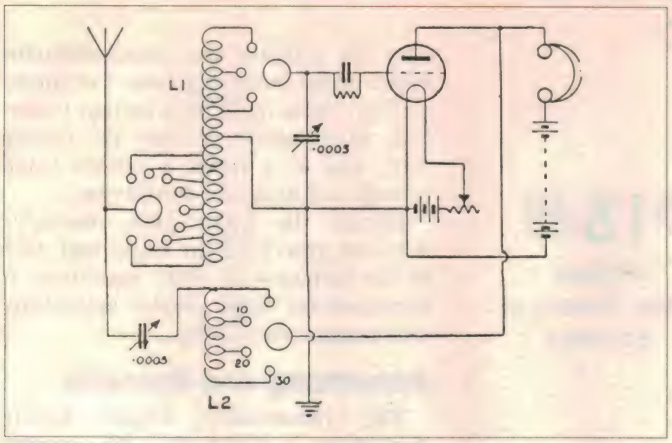

Fig.2: The Reinartz regenerative circuit of 1922. It still bears his name to this day.

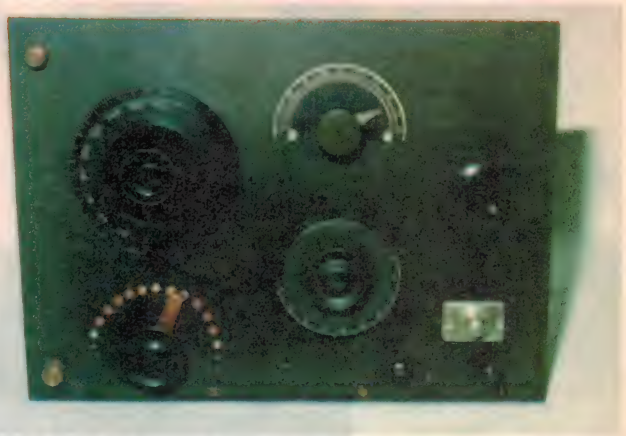

Fig.5: This single valve reflex of dubious provence has an impressive array of controls.

to this day bears his name, is shown in Fig.2. This circuit was said to be particularly good on 'short waves' — which are now the broadcast band frequencies.

Valves at this stage in history had become more reliable, and by virtue of engineering, research and design experiments, had become used as audio amplifiers, oscillators and in multi-valve receiving circuits — not to mention power RF amplifiers, otherwise known as 'transmitters'. The all-valve station was here to stay.

Regenerative detectors

It may be a good idea to give a few words of explanation here about the way regeneration works. It is not labouring the point to state that the explanation is much simplified.

When the tuned circuit is tuned to an incoming signal, the RF feedback has the effect of counteracting the so-called 'positive resistance', or losses, which reduce the performance of any tuned circuit. Positive feedback, or regeneration, effectively increases the 'Q' of the tuning circuit. (One definition of 'Q' is frequency divided by bandwidth. If the frequency remains constant, and the 'Q' increased, the bandwidth must decrease. This means that the circuit becomes much more selective.) As the dampening is reduced, the losses are reduced, and the circuit becomes more sensitive.

The overall 'Q' of the tuning circuit is actually different for each setting of L and C, the so-called 'LC' ratio, which is the reason why the amount of feedback has to be carefully adjusted for each incoming frequency.

Commercial one valvers

Anthony Constable in his book *Early Wireless* tabulated the results of a survey of all manufacturers who advertised their products in the popular press for 1926. Whilst this gives no indication of the numbers of sets actually produced and sold, it gives an insight to the relative quantities of one-valvers.

Constable notes that there were 97 crystal sets, 25 valve-crystal sets, 38 one-valvers, 127 two-valvers, 128 three-valvers and 163 four-or-more-valvers that were available to the British public in 1926. America, on the other hand, was practically bereft of commercially made one-valvers apart from the very earliest days.

In Australia, there is no doubt about the popularity of one-valvers. They were mainly assembled by the dealers, and quite often given some sort of identification by a dealer's name engraved on the panel, or a small brass plate stamped with their names and placed somewhere within the cabinet.

Reference to the advertisements indicates that one-valvers could be made to order, or kits of parts supplied for home constructors. It is safe to say that the big firms did not manufacture or market one-valvers.

Reflexing

Mention of one-valvers would not be complete without at least a passing reference to reflex receivers. A quote from long ago was 'reflexing was the invention of the Devil and Philips'.

Reflexing was an attempt to get the one valve to do two jobs. After using it for RF amplification, the signals were detected and then the audio fed back through the valve once again for AF amplification. Valves of the era were expensive, and if the valve could be made to perform the function of RF amplifier *and* AF amplifier, a cost saving could be achieved for a receiver that supposedly outperformed the usual one-valver.

However there was a trade off. The valve had to be tamed in order to prevent uncontrollable oscillations, and this was achieved by a reduction in gain — either by controlling the emission via a filament rheostat, or reducing the anode voltage. Often, the reduced operating conditions resulted in a performance which did not exceed that of a well-designed Reinartz circuit, in which the valve was operating under maximum conditions!

A closer examination of the reflex sets, and the development of twin triode and triode-pentode valves will complete the one-valver story in a future article. ❖

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(See page 118)

NEWS HIGHLIGHTS

MISSILE DETECTION THROUGH DUCTING

Researchers at Australia's DSTO (Defence Science and Technology Organisation) are developing new performance prediction software which allows exploitation of the ability of microwave radar to 'see' beyond the horizon, using an effect known as ducting. The technique, which is made possible by the refractive properties of the atmosphere, has the potential to improve defence against sea-skimming missiles by extending the range of RAN ships' radars.

The detection range of a shipborne microwave radar or Electronic Support Measures (ESM) system is normally limited by the earth's curvature, and for antennas located on ships, detection ranges are typically 20km. This provides just seconds for the ship's defence system to react, and missile designers are exploiting this by introducing faster missiles and salvos that saturate the ship's defences.

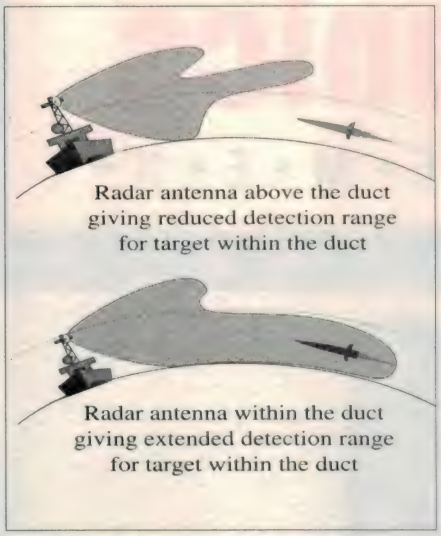
In a completely uniform atmosphere, the electromagnetic energy emitted by a radar system travels in straight lines, like light. However, the atmosphere is not uniform and radiowaves commonly curve downwards as they propagate. Ducting occurs when the downward curvature of the waves is strong enough for the energy to be trapped in a layer close to the sea surface. The most commonly observed type of duct over the sea is called an evaporation duct, because it is largely due to the evaporation of sea water.

An evaporation duct is nearly always present over the oceans surrounding Australia and is typically a few tens of metres thick, although duct thicknesses can range from a few metres to over 100 metres. All shipborne radiowave systems — including radar, ESM, navigation and communication systems — are potentially subject to ducting effects if they are directed towards the horizon.

Propagation at high elevation angles is not affected. Ducting effects are strongest at high frequencies, particularly in the SHF band above 3GHz. As the duct thickness increases, ducting effects extend to lower frequencies.

DSTO's Microwave Radar Division in Salisbury, SA is developing software for modelling the effects of ducting on radar system performance. The software is called TREPS, for Tropospheric Refractive Effects Prediction System, and has two main components. A propagation module calculates how the energy emitted by the radar system is transmitted through the atmosphere, while an environment module determines the prevailing ducting properties of the atmosphere from meteorological data entered by an operator.

The TREPS software runs on a PC and is intended to form an integral part of the Tactical Environment Support System (TESS), currently used on RAN ships and submarines and Maritime Patrol Aircraft to predict how the physical environment affects the performance of weapons and sensors.



Radar antenna above the duct giving reduced detection range for target within the duct

Radar antenna within the duct giving extended detection range for target within the duct

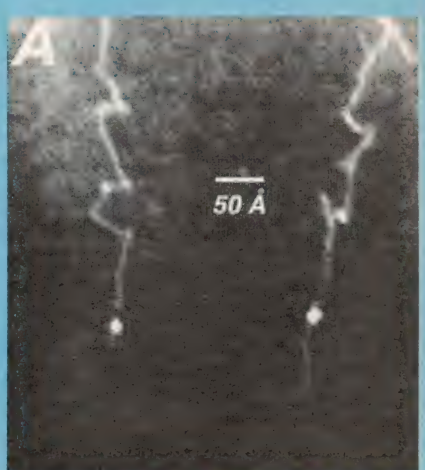
WORLD'S SMALLEST WIRES DEVELOPED

Just how small can you make wires for electronic circuits? The obvious, if fanciful, limit is the size of the atoms from which they're made. Well, that limit now seems to have been reached by a group of Cornell University chemists. They've managed to construct wires with a diameter of a few atoms — and encased them in plastic!

Francis DiSalvo and Jean Frechet, both Professors of Chemistry at Cornell University, led a team of researchers who took atoms of the metallic substances molybdenum and selenium separated by lithium. The lithium was removed when the material was immersed in a solvent of ethylene carbonate, leaving the metals behind in the form of strings up to 10,000 Angstroms long. The solvent was then polymerised, encasing the tiny wires before they had a chance to clump together. The result is a collection of wires three atoms in diameter and up to 10,000 atoms long.

The researchers weren't even sure they'd achieved anything until their colleagues John Silcox and Malcolm Thomas from Cornell's Materials Science Center analysed the tiny wires using a process of scanning transmission electron microscopy. The images, produced when electrons scatter from a scanned atom-sized electron beam, show single six-angstrom diameter wires, double wires, and 'cables' up to 40 angstroms across.

The scientists don't know what to do with the wires just yet, but point out that in time, others will put the electrically conductive wires to use. Until then, there are some basic problems to overcome, such as figuring out how to join the wires to form an electrical circuit. The scientists would also like to know how the wires behave under different conditions, such as high and low temperatures. (Geoff McNamara)



NSW STUDENT'S 'DIGITAL COMPASS'

Adam Doyle, designer of the Digital Compass, is congratulated by NSW Minister of Education and Training John Aquilina MP.

The invention of digital clocks changed our lives, as have other forms of digital measurement. A young designer has now produced a digital drawing compass which has him being acclaimed as an emerging talent in the field of design and technology.

Adam Doyle, from Coffs Harbour High School, had his digital compass selected to be among the 22 works on display in DesignTech 96, now showing at the Powerhouse Museum, Sydney. It was chosen from 5000 major design projects submitted for the Higher School Certificate examination in Design and Technology.

Adam's project comprises a technical drawing compass with added electronics which gives a reading of the distance between the compass points on a digital readout.

When asked what features distinguish his work, Adam said:

"The digital compass is unique; I think it's the first time such a concept has been developed. It offers a cheap alternative to Computer Aided Design (CAD) and gives accurate results."

He said he is interested in seeking business backing to develop the compass further, and then marketing it.

DesignTech 96 was officially opened by the Minister for Education and Training, John Aquilina MP, who said the high standard, originality and technical proficiency of these students' works amazes visitors each year.

DesignTech 96 is a joint project of the Board of Studies NSW and the NSW Department of School Education, and receives support from the Australian Cotton Foundation. The exhibition will be at the Powerhouse Museum until 27 February, 1997.

JAPAN BUYS AUST BROADBAND ANALYSERS

Hewlett-Packard's Australian Telecommunications Operation (ATO) has signed a major export agreement with Nippon Telegraph and Telephone Corporation (NTT), the world's largest telecommunications company, to help bring a range of high-value multimedia services to Japanese customers over the first commercial high speed asynchronous transfer mode (ATM) network in Japan. The nationwide ATM network will enable NTT to deliver new multimedia services, such as video on demand, real-time video conferencing and high-speed Internet access.

As part of the agreement, NTT will initially purchase 19 of HP's E5200A Broadband Service Analysers, which have a list price of approximately $60,000 each depending on configuration. HP and NTT also plan to develop jointly specialised hardware to allow remote testing with the E5200A Analyser and the HP Broadband Launch Pad. The Australian-designed HP test equipment will monitor and maintain NTT's ATM cell-relay network, which is expected to operate at speeds from 1.5Mb/s to 155Mb/s.

"The international success achieved by HP's research and development engineers is evidence that Australia is becoming a dominant force in the global telecommunications industry", said Bill Wood, general manager of ATO.

TOSHIBA CLAIMS SMALLEST CAMERA

Japan's Toshiba Corporation has released what it claims as the world's smallest digital camera — a PC card-based model for use with portable PCs. The camera provides notebook PC users with a tool for high speed capture of video images and still pictures by taking advantage of the 32-bit CardBus interface. Toshiba says the camera opens the way to bringing such advanced functions as video conferencing to portable computers.

The new camera unit, IK-D30, consists of the camera head, cable and PC Card. The Cam-Head weighs in at only 130 grams. Mass production is scheduled to start during the first quarter of 1997, with the end user price around US$500. Toshiba says the IK-D30 is the first PC camera to be designed for the CardBus interface (a PC Card format) and its 32-bit bandwidth, which offers more than twice the transmission speed of current 16-bit digital video systems — attaining a maximum transmission speed of 132 megabytes a second. The wider bandwidth supports high speed transmission of digital video signals to the computer's system bus, even at higher levels of resolution than other systems, including NTSC analog TV transmissions. Captured video images are delivered to the computer as digital signals via the cable and the unit's PC card, which is inserted in the computer's CardBus slot.

The new camera is based on a 330,000 pixel charge-coupled device (CCD). This provides true 640 x 480 image capture using non-interlaced (progressive) scanning techniques. An additional plus is that the unit does not require a separate power supply but runs on the computer's power supply via the PC Card, eliminating the need for additional batteries or bulky AC converter and power cable. Typical power consumption is one watt.

SMALL MFRS & THE EMC FRAMEWORK

Although manufacturers producing very short runs of electronic equipment, or importing very small quantities, were originally going to be exempted from conforming to the SMA's EMC Framework, this is no longer the case. Firms in this position should be aware that they are now covered by the Framework requirements, which were apparently amended by the SMA's Radiocommunications Standards Team earlier this year.

The SMA's David Brumfield explained that although the exemption for small manufacturers/importers has been dropped, the requirements for testing of equipment have also been amended — so that testing at a NATA Accredited laboratory is no longer mandatory. In order to reduce costs and also time to market, suppliers can now sign a Declaration of Conformity, based on

HPM Industries' new Nurse Call system allows patients and staff in hospitals and nursing homes to communicate with a central station conveniently, and also provides security alarm functions. It uses ELV wiring and can be installed by electrical contractors.

testing of their own or that carried out by a non-Accredited laboratory or test facility, and supported by that test data.

Whether this provision will provide an acceptable-risk system for small firms remains to be seen, however, because the SMA's Guidelines make clear that test data from sources other than NATA Accredited laboratories are regarded as carrying a higher risk in relation to claims for product conformity. In the event of an audit, the supplier may be required to bear the cost of supplying samples and having them tested at a NATA Accredited laboratory.

Further information is available from the SMA Radiocommunications Standards Team in Canberra; phone (062) 56 5274 or fax (062) 53 2424.

SKY RADIO EXPANDS DIGITALLY

Australia's largest commercial radio network, Sky Radio, has expanded its capabilities with new technology using the latest digital audio satellite distribution system.

Sky Radio, which distributes leading talk personalities John Laws and Stan Zemanek and an extensive range of programs and services including the American ABC and CBS news, Bonform music programs and operates a commercial delivery service, has boosted its future expansion plans with the installation of its own distribution system by leading technology group Comsyst.

Sky Radio will use the International Datacasting Corporation's (IDC) satellite distribution system, which allows multiple programs to be received as well as serial data and contact closures for the control of external equipment such as hard disk storage devices, cart machines and reel-to-reel units.

The digital stereo service has replaced the B-MAC service previously used by Sky Radio through Sky Television. The new service is uplinked to the Optus Satellite by the Nine Network and the satellite footprint covers all of Australia and New Zealand. The uplink at Channel 9 in Sydney is fed with a 2Mb digital microwave link from Sky Radio's operational centre in Greenwich, Sydney.

The Managing Director of Comsyst, Mr Mario Fairlie, said the system was 'the way of the future' for radio stations. "There can be no doubt that radio networking enters a new era with this installation and other networks will soon have to follow suit", he said. "The improved quality of reception and the greater flexibility provided by the new IDC equipment revolutionised radio networking in Australia and New Zealand."

The General Manager of Sky Radio, Mr Brendan Sheedy, says Sky Radio distributes programs to 140 commercial radio stations throughout Australia and with the new digital system is now ready to expand into New Zealand.

Digital audio outputs have the advantage of achieving a minimum 20kHz bandwidth and may be routed directly to air or input directly to a digital audio storage device.

The ABC also uses the IDC range of satellite digital audio distribution products to distribute its range of audio programs to re-transmission sites throughout Australia. The ABC installed the system last year (1995) and it is now one of the largest digital audio satellite distribution systems in the world.

FOUR LAYER PCB PROTOTYPE SERVICE

South Australian firm Don Alan has launched a four-layer PCB prototyping service to coincide with the increased demand brought about by the new EMC regulations. The service is aimed at providing top quality four-layer PCBs in small quantities without the tooling charges being prohibitive. Special techniques are used to reduce tooling costs to less than those normally charged for double-sided PCBs.

All PCBs are through-hole plated, have solder resist and component overlay. A normal 8-mil track clearance applies. Tooling can be Gerber files or a range of common PCB file formats.

Further information is available from Don Alan Pty Ltd, 107A Burbridge Road, Hilton 5033; phone (08) 8443 3957 or fax (08) 8234 5339.

OBIAT NOW ON THE 'NET

Test instrumentation specialist Obiat has established its Website on the Internet. The site is a virtual catalog of the wide range of test and measurement equipment supplied by Obiat from major leading manufacturers world-wide, providing a one-stop location from which to select just about any T&M product. It includes full-colour pictures of products, with details and specifications plus Hypertext links to original manufacturers, where applicable, to provide even more information.

Users can obtain pricing and delivery information, quotations and even place orders for products. The Website address is: **http://www.obiat.com.au**.

Products described on the Website include digital and analog multimeters, oscilloscopes, electrical test products including insulation ground resistance, LAN cable test sets, signal conversion devices, AC and DC current clamps, power analysers, frequency counters, signal sources, power supplies, products for temperature, speed and sound level measurement, calibrators and precision power sources, logic analysers and a wide range of accessories. Some of the major brands represented include Analogic, AEMC, AV Power, Blackstar, California Instruments, Fluke, Kepco, Metrix, Pantec, Sadelta, Silvertronic and Tempcon.

For more information, contact Obiat on (02) 9698 4111 or fax (02) 9699 9170.

PC97 FOR SYDNEY

PC97 is to be staged at Sydney's Convention and Exhibition Centre, Darling Harbour from June 4 - 7. The promoters claim that some 80% of floor space is already booked, for the computer show that traditionally marks the start of the Australian computer and IT calendar year. Australian Exhibition Services anticipates that the event will attract some 50,000 business visitors over the four-day show period.

"The PC Shows continue to grow in keeping with the pace of an industry that is continually broadening its reach the world over. PC 97 Sydney will give visitors a window to the future", said Chris Murray, Exhibition Director. "Everything imaginable for building up a stronger and more far-reaching business is on display in the one place at the one time at the PC Shows.""Computer technology now touches everyone, from small businesses to multinational corporations, and PC 97 Sydney will cater to all areas of the business world. Visitors have the unique opportunity to see the most up-to-date and futuristic technology and gain an idea of where the business world is heading." he said.

Firms who have already booked for the show include Banksia Technology, Canon Australia, Epson Australia, Fuji Xerox, Fujitsu Australia, Gateway 2000, Hewlett Packard, Hypertec, NetComm, OzEmail and Vodafone.

PC 97 Sydney will be open to all business visitors only.

PHILIPS TO BUILD MULTIMEDIA CHIP

As part of its strategy of providing an open platform which will drive the development of new, innovative multimedia applications, Philips' Trimedia product group has formed a development partnership with InVision Interactive Inc., a leader in digital audio technology. Under the agreement, Philips will integrate CyberSound's sophisticated music synthesis technology in the forthcoming TriMedia TM-1 programmable multimedia digital signal processor, central processing unit (DSP/CPU) chip. Additionally, the CyberSound code libraries will be available to TriMedia customers so that they can develop state-of-theart audio capabilities for their multimedia applications.

These new capabilities are in addition to TriMedia's support of Microsoft's direct application programming interface (API), including the direct sound interface. This gives the TM-1 chip powerful sound effects and positional audio capabilities. The combination of industry standard API support and CyberSound's innovative technology will enable TM-1 customers to more easily develop sophisticated multimedia applications using advanced sound capabilities.

The TriMedia chip is capable of concurrently processing audio, video, graphics and communications data at up to four billion operations per second. Combining these functions on one DSP/CPU makes it possible to create entertainment, education, set-top TV, and video conferencing products with an affordable price and high performance aimed at both the PC and consumer markets.

The TriMedia core is based on the VLIW (Very Long Instruction Word) architecture and is fully programmable in high-level ANSI compatible C and C++ languages on UNIX and PC platforms.

ELECTRONICS SHOW FOR MELBOURNE

In a joint announcement, the Australian Electronics Development Centre (AEDC) and Practical Marketing the promoters of the national electronics exhibition 'Electronics at Work' have outlined the major education program for this year's enlarged exhibition, now to be staged in the World Trade Centre in Melbourne on June 18 - 19.

AEDC Director Ms. Deborah Davis.

Industry majors such as Ericsson, AWA, HP, IBM, NEC, SEC, Siemens and Telstra, together with the Federal and Victorian State governments, originally formed the AEDC in 1989. Since then, more than 1000 organisations have sent employees to AEDC educational courses, workshops or events, and Director Deborah Davis estimates that over 2000 industry personnel participated in programs last year.

In her announcement of the AEDC education program for next year's Electronics Expo, Ms Davis quoted the success of the 1996 event staged in Sydney in conjunction with the Spectrum Management Agency, where 15 workshops attracted over 400 participants.

"Australian electronics companies are well aware of the competitive environment in which they now operate, and the need for Australian industry to become internationally competitive in order to effectively compete in global markets. In response to the industry's needs we have expanded the range of courses offered and welcome again this major national forum to address topical issues of urgent need for electronics companies", stated Davis.

"The success of last year's event led to AEDC being invited to take over the whole education program for Electronics at Work in 1997 and has allowed us to offer the industry a conference and a dynamic series of workshop seminar sessions where delegates will support the AEDC itself by their attendance and assist our wider educational activities."

The 1997 show itself has expanded and Practical Marketing reports that some 60% of the available space is already booked by industry majors including GEC, Philips, Adilam, Farnell Components, National Instruments, Mayer Krieg, Rohde & Schwarz, Sun Industries, Augat and others. ❖

NEWS BRIEFS

- GEC Electronic Division is now the sole distributor for Zilog in Australia and New Zealand.
- The ***CEDIA Asia/Pacific Expo 97*** will be held at the Hyatt Regency Hotel, 7-9 February 1997. The exhibition has short training courses for those involved in custom electronic or related industries. Enquiries on (02) 9369 2717.
- Andrew King has been appointed by ***Scientific-Atlanta*** as sales manager for Satellite Television Networks in Australia and New Zealand.
- Thomas and Betts, a US producer of connectors and components is acquiring ***Augat Inc*** in an exchange of stock.
- The 25th ***International Exhibition of Inventions, New Techniques and Products of Geneva*** is to take place at Palexpo, April 11-20 1997. Enquiries on Geneva (004 122) 736 5949.
- Gareth Jude has been appointed Merchandise Manager at electronics distributor and retailer ***Dick Smith Electronics***. Mr Jude was formerly Wholesale Division Manager, and replaces Ross Whitelaw who has left the company after nine years of service in senior management. ❖

Product review:

FLUKE'S 164T MULTIFUNCTION COUNTER

Modern test equipment has changed little over the past few decades. It's faster, cheaper and more accurate perhaps, but as far as anything *new* is concerned, we just seem to be twiddling much the same knobs we were 20 years ago. But Fluke's engineers have recently turned their attention to one of the more overlooked pieces of test equipment, the frequency counter, and the results are interesting to say the least.

by GRAHAM CATTLEY

Fluke's new 163/164 series of MultiFunction Counters break away from the traditional image of frequency counters, with a chunky hand-held unit capable of a wide variety of frequency measurement and counting functions.

You may think 'Seen one counter, seen 'em all', but when you see this counter's large LCD screen displaying a waveform, the possibilities unfold before you. 'See what you count, count on what you see' is how Fluke put it, and anyone who has used a frequency counter will know exactly what they are talking about.

Measure almost any waveform with a conventional frequency counter, and you're more than likely to get a reading that differs for each setting of the counter's trigger level. More often then not, it's a case of 'pick a number' — adjusting the trigger level until you get a reading that is close to the expected frequency. The reason for this is that noise on the waveform causes the counter to clock up extra counts within its gating period.

With a new Fluke MultiFunction Counter (MFC), however, the waveform is graphically displayed on screen, allowing you to see the incoming waveform and manually set the trigger level (represented by a horizontal line across the trace) to a 'clean' part of the wave. The ability to see exactly where you're triggering eliminates the guesswork, and gives you a much better feel for the reading you are taking.

More than a counter

As its name would suggest, the MultiFunction Counter is much more than just a frequency counter; rather, it is a highly versatile waveform analysis tool that is capable of a wide variety of functions. As well as the more usual frequency and period measurements, it can also measure burst frequency, burst repetition rate, frequency ratio (f1/f2), time interval (between pulses), positive and negative pulse widths and duty cycle. Rise and fall times, phase relationships (to 0.01°) and pulse counting are also supported, along with a raft of statistical functions including minimum, maximum and mean frequency, phase and voltage readings, as well as standard deviation and peak to peak deviation (max-min).

All of these features can be accessed through a highly intuitive menu selection system, and context-sensitive help for all functions is available at the press of a key.

The Fluke MultiFunction Counter is available in two models, the 163 and 164. Both have a measurement capability of 1uHz to 160MHz on two channels, while the 164 series contains one extra input channel, allowing read-

ings of up to 1.3GHz.

Measuring 65 x 140 x 275mm, and weighing in at 1.8kg (including rechargeable batteries and holster), the MFC is perhaps not best described as a hand held device — more of a portable unit, able to be moved easily from place to place. Battery life is quoted at around 1.5 to 2.5 hours between charges, depending on the model. (The unit will also run on four 'C' cell alkaline batteries, but these would have to be removed when using the power adapter, to prevent them from being charged.)

Fluke were kind enough to send us a MFC 164T unit to review, which has the third input capable of handling frequencies up to 1.3GHz. The T suffix indicates that the unit contains a temperature compensated crystal oscillator (TCXO), which provides a timebase with an aging rate of 1×10^{-6} per year. Another option is the 164H, which contains an oven controlled crystal oscillator timebase, with an aging rate of 1×10^{-7} per year. The counter is supplied along with an inline power adapter, rechargeable batteries, a user's manual and quick start guide, and its certificate of calibration to ISO 9001.

First impressions

The first thing you notice about the MFC is the large liquid crystal display that takes up slightly less than half of the front panel. Below this are 16 clearly labelled rubber buttons, plus a four-way cursor keypad.

Fluke has opted for fixed-function buttons, instead of the more common 'soft buttons' found on most digital instruments. With one button serving only one function, operating the MFC is extremely straightforward — you never get lost in complicated submenus. Also, the user interface is non-modal, that is, you can always get straight to any function you want simply by pressing its key. A lot of thought has obviously gone into how the device will be used.

The three buttons in the top row select the three different display modes: Waveform, Values and Statistics. In waveform mode the device looks very much like a digital oscilloscope, with the current frequency reading displayed above a reasonably sized waveform display.

By using the cursor keys, it is a simple matter to move around the screen and change any of the counter or scope's settings. It's worthwhile noting here that the scope and counter are displayed as two completely separate instruments, and that the trigger level, V/div and timebase on the scope can be set independently of the counter's trigger level.

A much simpler way to configure all of these separate settings is to press the light green 'Auto Set' key at the bottom of the keyboard. This configures the MFC to display two complete cycles of the incoming waveform, and also sets the counter's trigger level to the waveform's mid point. The Values mode displays frequency, average period, Vmax, Vmin, and Vp-p, and offers a faster display update than waveform mode, as it doesn't have to keep updating the scope screen. Statistics mode displays all of the above mentioned statistical functions, as well as giving you the option to set the sampling size from two to 1,000,000 samples.

All of the counter's other functions are accessed by pressing the orange Measure Function key. This brings up a set of nine on-screen buttons for selecting phase, period, voltage etc. Selecting one of these returns you to the current display mode with the selected measurement displayed.

One useful feature is an Undo button that reverses the effects of your last action — very handy for toggling between modes.

Ins and outs

Inset into the top end of the unit are four plastic-covered BNC sockets, and in the case of the 164 series, one extra metal BNC socket for the HF (1.3GHz) input. Plastic sockets are used primarily for safety reasons, as all of the counter's ground connections are commoned and metal sockets would present a safety hazard if a high voltage were present on one of the inputs. (The need for a metal socket for the HF input would seem to invalidate this concept, and this is reflected in the maximum input rating for the 164 series being 30Vrms instead of the 100Vrms rating for the 163 series.)

As well as the three signal inputs, there is an input for an external 10MHz reference timebase, and a reference frequency output. This output provides a menu selectable test signal over the range of 1Hz to 10MHz in 12 steps, as well as high/low duty cycle pulses at 1kHz. A 2kHz probe adjustment signal is also available, as is a gate monitor signal that swings high at the start of triggering.

Conclusion

My first thought on seeing this instrument was that it was a frequency counter trying very hard not to be an oscilloscope. But having used it for a couple of days, I have realised that this is not the case. The MultiFunction Counter is a number of instruments all rolled into one: an oscilloscope, albeit without all the bells and whistles of a dedicated DSO; a wideband DVM; a phase meter and a waveform analyser, as well as a high accuracy frequency reference and, of course, a frequency counter.

To top it all off, all of these functions can be controlled by your PC using the optional RS-232 opto isolated interface. This allows you to use the FlukeView Windows software (supplied with the interface) to download numerical data, print screen dumps, log and graph readings and even update the MFC's firmware when a new version comes along.

As you've probably guessed, I'm quite impressed with this latest offering from Fluke, and I think that the MFC will fit in very well on the workbench as an instrument that takes over where an oscilloscope leaves off. If you are thinking of buying a new piece of test equipment, the Fluke MultiFunction Counter is certainly worth considering.

The Fluke MultiFunction counter is available at a RRP of $2495 for the 163, and $2995 for the 164 models. The 164T (TCXO) and 164H (oven) models are an extra $900 and $1500 respectively (all prices are excluding sales tax). All are available from Philips Test and Measurement, and also from their network of dealers. ❖

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DOUBLING THE RANGE OF YOUR RF GENERATOR

Is your old RF signal generator too limited in its frequency range? There's no need to replace it — you can effectively double its range for an outlay much lower than buying a new one. Here's how it's done...

by JIM ROWE

How many times have you wanted to use your trusty RF signal generator to check a receiver, filter or other circuit, only to realise that its frequency range simply wasn't good enough? Many RF generators that are otherwise quite serviceable have a frequency range that can fall short of modern needs.

If money were no object, the answer would be to replace these ageing generators with a modern instrument, with a frequency range extending up into the microwave region and all of the latest 'bells and whistles'. The problem is that today's RF generators generally have a price tag equating to the proverbial 'arm and a leg'. For most of us, buying one really isn't an option — and even the cost of renting one for a week or two can be difficult to justify.

Happily there *is* a way that you can often still use your existing generator, by effectively *doubling* its frequency range — and for a much smaller outlay. This is by using a passive wideband frequency doubler.

A frequency doubler is a small device internally almost identical to a double-balanced mixer. Inside there's typically a couple of wideband RF transformers plus a 'ring' of high speed diodes. The difference is that whereas a normal double-balanced mixer is used to take two different RF signals (say an incoming RF signal and a local oscillator), producing their 'sum' and 'difference' signals (such as an IF signal), the frequency doubler is effectively fed with the *same* RF signal to both mixer inputs, so it produces a 'sum' output of twice the frequency:

$F1 + F1 = 2F1$

Another way of looking at this is by considering the mixer as an analog multiplier, which multiplies the incoming sinewave at F1 with the same signal shifted in phase by 90° (effectively a cosine wave), to again produce a signal at twice the frequency:

$\sin(F1) * \cos(F1) = 0.5 * \sin(2F1)$

Needless to say, as with any non-linear device the output of the frequency doubler also contains other components — in particular, the input signal's fundamental and other harmonics. Because of the balanced nature of the doubler's circuitry the fundamental and odd harmonics are usually quite small, but the fourth harmonic and other higher-order even harmonics can be significant.

As you'd expect, the passive nature of the doubler also results in a conversion loss — you get less energy out than you have to put in. However this loss is not great and is relatively constant over the operating frequency range, making it fairly easy to allow for.

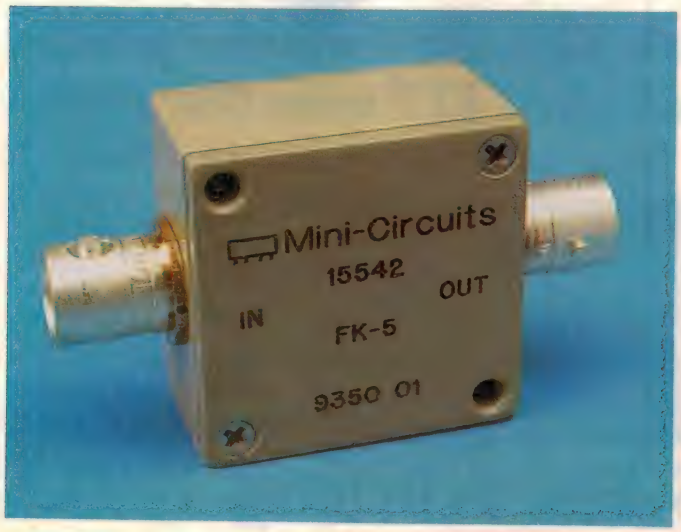
The nett result, then, is that a wideband doubler can effectively convert the output of a generator into a reasonably 'clean' signal of double the frequency.

A good example is the type FK-5 doubler made by US firm Mini-Circuits Inc. This is housed in a case measuring only 32 x 32 x 19mm, and fitted with BNC connectors for input and output. With 50Ω input and output impedances, it accepts input signals over the range 10 - 1000MHz and doubles them to provide signals up to 2GHz. The conversion loss is less than 15dB (typically 13dB) for input signals up to 600MHz, and less than 17dB (typically 14dB) for signals between 600MHz and 1GHz. The fundamental output is typically a further 20dB below the doubled output, while the third and fourth harmonics are typically both 25dB below the doubled output.

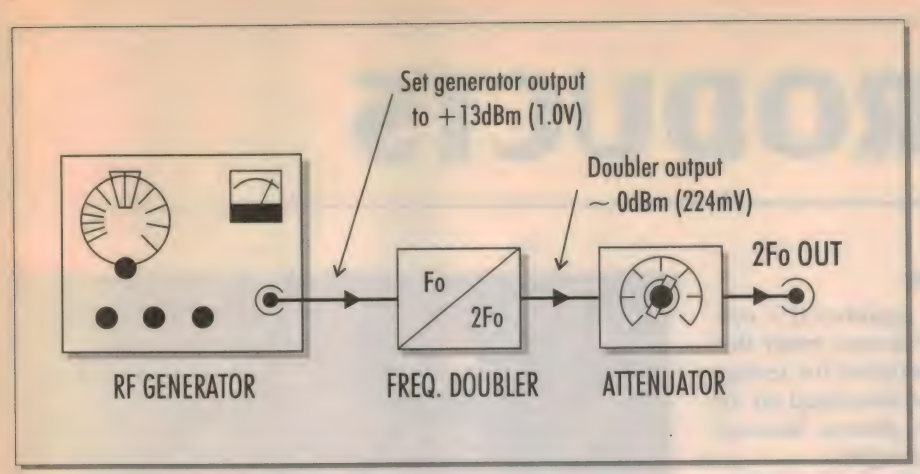
As you can see, this performance makes the FK-5 very suitable for use as a frequency doubler for earlier-model RF generators. And the good news is that the FK-5 costs only $132.90 plus tax — much less than the cost of a new generator!

There is a trick to using this kind of frequency doubler, however. As a passive device which relies on the non-linear mixing action of semiconductor diodes, the doubler needs to operate at a reasonably high signal level. You can't simply connect it to the output of the generator, and expect it to double efficiently at any convenient RF output level. In fact as the input signal level is reduced, the conversion efficiency of this kind of doubler drops away quite rapidly — of if you prefer, its conversion loss rises rapidly.

What this means is that to operate the doubler at its full efficiency (i.e., minimum conversion loss), you need to set the RF generator for a fairly high output level and keep it at that level. With the FK-5 doubler, for example, the input level needs to be at



The Mini-Circuits FK-5 passive frequency doubler, shown a little larger than actual size. It provides a cost-effective way to double the frequency range of ageing RF generators.



As the frequency doubler needs to operate at a reasonable RF level for optimum conversion efficiency, it's used in this manner. An outboard attenuator reduces the doubled output to the desired level.

least +10dBm (i.e., 700mV RMS into 50Ω). Since the conversion loss is about 13-14dB, it's often convenient to set the input level to say +13dBm, so that the doubled output will be at about 0dBm (224mV across 50Ω).

Of course most of the time we need a much lower RF output level than this from an RF generator. So when you're using this kind of doubler, you also need to use an outboard RF attenuator to reduce the doubled output down to the levels you really need for testing.

For some kinds of testing, fixed attenuator pads may be suitable, although in most cases this won't give enough flexibility. The best idea is a fully adjustable attenuator, allowing adjustment of the output level in at least 1dB steps over a range of say 110dB, or preferably 120dB (taking you down to about 0.2uV).

Needless to say, this kind of adjustable attenuator generally isn't cheap either (especially those offering reliable calibration above 1GHz), but you can sometimes pick them up at bargain prices.

So the basic setup you need for using a frequency doubler like the FK-5 with your RF generator is shown in the diagram. The doubler is connected directly to the generator output, with the generator output set to say +13dBm (1.0V RMS). Then the doubler output at approximately 0dBm is fed to the attenuator, to reduce it to the level you need. It's not difficult, and will generally work out a lot cheaper than investing in a new generator.

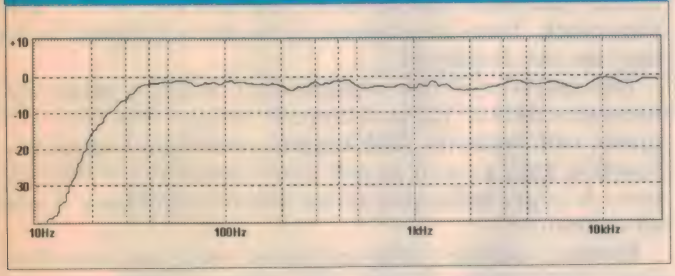
The FK-5 Doubler is available in Australia from the distributor for Mini-Circuits, Clarke & Severn Electronics of Unit 4, 8A Kookaburra Road, Hornsby Heights NSW (PO Box 1, Hornsby 2077); phone (02) 9482 1944 or fax (02) 9482 1309.

Incidentally Mini-Circuits also makes a range of wideband fixed attenuators, in both component form and enclosed form with a range of coaxial connectors. These are available from Clarke & Severn Electronics as well. My thanks to Mr Gordon Clarke of CSE for his help in the preparation of this article. ❖

NOTES & ERRATA

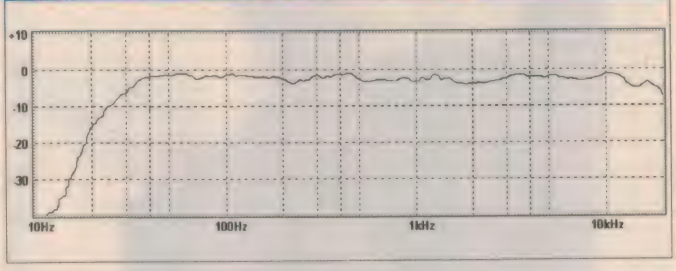
VAF DC-X Kit Speakers (January 1997): Due to an unfortunate printing error, the plots for frequency response, phase response and electrical impedance did not appear on page 73. The missing curves are shown below (we hope!):

Fig.1: Frequency vs amplitude at 3m on the tweeter axis



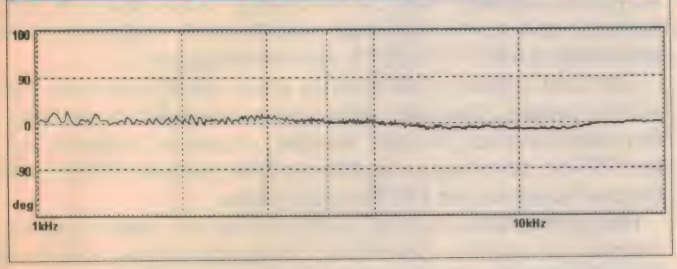
VIPA 10dB/div sm 1/3 oct Calibrated measurement

Fig.2: Frequency vs amplitude at 3m - 30 degrees off axis



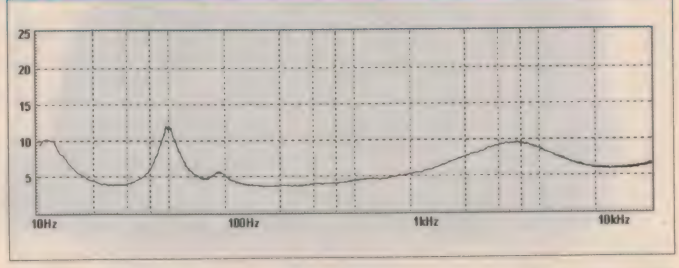
VIPA 10dB/div sm 1/3 oct Calibrated measurement

Fig.3: Phase response measured at 3m on the tweeter axis



VIPA Delay Auto 360 deg Calibrated measurement

Fig.6: Electrical impedance vs frequency



VIPA 25ohms FSD RCal=10ohms Linear measurement

NEW PRODUCTS

ISDN basic rate access tester

Wandel & Goltermann has recently introduced a new ISDN tester, the IBT-5 ISDN basic rate access tester that looks like a telephone, but includes facilities for testing SO and U interfaces. The test results are presented on the unit's built in display and users can choose between English, French, German and other languages.

Features include network and terminal simulation, BERT, service tests and a loop box function. It also has test menus and a simplified tracer function with interpretation capabilities. Software updates can be loaded into the device's internal memory to cater for future developments.

The device is powered from the mains or built-in NiCad battery pack. It is suitable for as a test tool for installers, network operators and service technicians who work with ISDN equipment and networks.

For further information circle 243 on the reader service card or contact Wandel & Goltermann, 42 Clarendon Street, South Melbourne 3205; phone (03) 9690 6700.

Compact GPS receiver

The GPS II, recently released by Garmin International, is a GPS receiver with a 'flip-flop' display which allows the unit to be mounted and read both vertically and horizontally, or used as a handheld device. GPS (global positioning system) navigation pinpoints a user's exact location on earth, providing speed, distance, bearing and graphical steering guidance to and from known .or unknown locations.

The display can be customised to suit the user's particular activity or preferences. For instance, the 'position page' displays track, speed and cardinal heading as well as the actual position. User-definable options allow a choice between a trip odometer, elapsed time, average speed, maximum speed, total time and a 12 or 24 hour time clock. These measurements are also calculated when they are not displayed.

The receiver is the smallest in Garmin's range and measures 58.9 x 127 x 41mm. It weighs less than 260 grams with batteries. The keypad contains six dedicated function keys as well as one-touch zoom in and out buttons. A large, rockerpad cursor control allows one-handed operation.

Features include 'point and shoot' first-time initialisation, 15-20 hours battery life, internal lithium battery backup for stored data between battery changes, moving map display with diagonal panning capability and zoom scales ranging from 0.32 to 580km. It also has 250 user waypoint capacity with 20 reversible routes and 106 map datums, and seven different grid formats including user definable AMG/UTM/UPS latitude/longitude.

The unit comes with a wrist strap, user's manual and velcro mount. Optional accessories include an automotive dash bracket, bicycle bracket, cigarette lighter adaptor, PC kit, carrying case, remote antenna and differential beacon receiver for DGPS corrections.

For further information circle 241 on the reader service coupon or contact Standard Communications, PO Box 296, Gladesville 2111; phone (02) 9844 6666.

FS meters for EMR up to 18GHz

Wandel & Goltermann has introduced two new field strength meters, the EMR-200 and EMR-300. The devices use interchangeable probes to measure electromagnetic radiation up to 18GHz. Their coverage includes the frequency ranges used by radar installations, radio broadcasting facilities and satellite systems.

Probes are available for electric and magnetic fields. All probes are isotropic for nondirectional measurements. The meters don't need measurement range switching and also allow an automatic zero alignment, even under exposure. They emit audible and visible alarms when the tolerable field strength limits are exceeded.

Each device and probe is individually calibrated to ensure reproducible results that are traceable to national standards.

For further information circle 250 on the reader service card or contact Wandel & Goltermann, 42 Clarendon Street, South Melbourne 3205; phone (03) 9690 6700.

Digital scope has recorder mode

The new DL1540 digital oscilloscope from Yokogawa has a footprint smaller than A4 size. It features four channels, 200MS/s sample rate (max), 150MHz bandwidth, 120K word length (max) and an inbuilt 3.5" floppy disk drive. Its update rate is independent of the number of channels in use.

The instrument is also a recorder that can capture pulses in real time down to 20ns on an optional built-in printer. With signals slower than 50ms/div, the scope shows a waveform on its 17.8mm CRT similar to a recorder, with a roll mode enabling information equivalent to two pages (20K words) to be kept.

The built-in floppy drive is MS-DOS compatible. It allows waveform data, panel settings and the display to be saved, and later included in a wordprocessor document. A history memory function stores the last 100 displays for later recall, and the instrument's zoom function enables a waveform to be magnified. A single key operation allows signals to be compared. Trigger functions include window and TV trigger, and pattern trigger. Pulse width and OR trigger can be added as options.

For further information circle 247 on the reader service card or contact Quiptek Pacific, PO Box 42, Southland Centre Post Office, Cheltenham 3192; phone (03) 9553 5000.

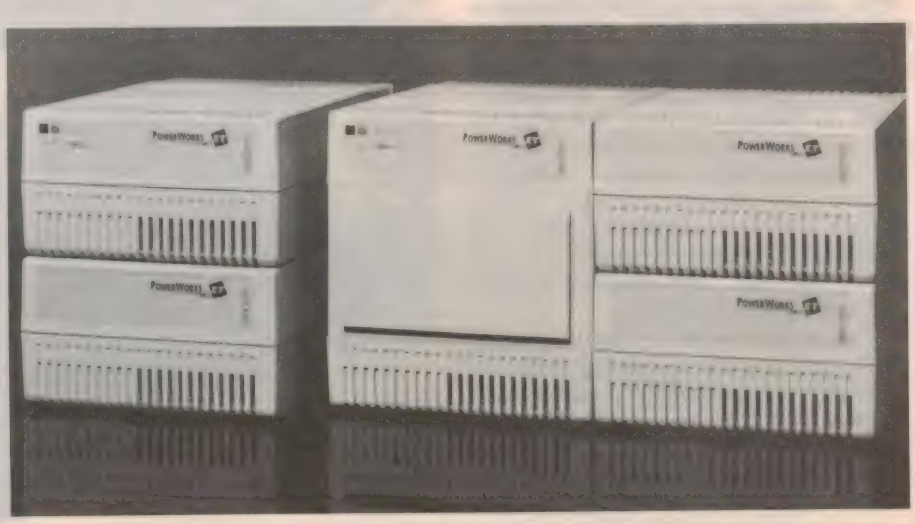
UPS has long battery life

The recently released PowerWorks ET UPS from Deltec is a modular on-line uninterruptible power supply (UPS) that features hot-swappable batteries, Cell Saver technology for increased battery life, and an automatic bypass switch to prevent loads from crashing.

Models within the range are rated at 1kVA and 2.5kVA, and are designed for harsh power environments where severe overvoltage and brownout situations occur. Cell Saver is claimed to increase the life of the UPS batteries by minimising battery usage during normal operation. By extending the input voltage range, the UPS regulates the power in a power surge or sag situation without using the batteries, saving battery backup time for protected systems during power outages. Battery modules can be hot-swapped, allowing users to replace or add modules without powering down connected loads.

Included is Deltec's Lan Safe III and FailSafe III power management software which automatically monitors protected systems and conducts an orderly and prioritised shutdown during an extended blackout.

For further information contact Deltec, 2727 Kurtz Street, San Diego, California 92110 USA; phone 619 291 4211.



Multi-trigger, two channel 20MHz scope

The new Kenwood CS4125 oscilloscope incorporates features such as relay switched attenuators in place of conventional rotary switch operation, auto-focusing to compensate for intensity changes and fast changeover to X-Y mode.

For repetitive waveforms the FIX synchronisation mode provides automatic trigger level detection. In the VERT triggering mode, two signals with different frequencies can be displayed. Other triggering modes include TV line and frame modes. The timebase sweep of 20ns/division has an accuracy of 3%. Both channel inputs are rated to 800V p-p and sensitivity is variable from 1mV/div to 5V/div.

The bandwidth is 20MHz (-3dB) in all attenuation settings in the range from 5mV to 5V/div.

The scope has a 150mm rectangular display that provides parallax-free operation. It comes with two switchable x1, x10 probes.

For further information circle 248 on the reader service card or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066; phone (03) 9419 9999, freecall 1800 623350.

DC-DC converter meets prETS 300-132

The CQ family of DC-DC converters from Melcher is compliant with the latest harmonised European telecom standard prETS 300-132, as well as with the EMC directive. The converters are designed specifically for 48V and 60V bus voltages, typically for broadcast, telecom and data transmission applications. The input voltage range is 35 to 75V, output power is 100W (free air to 71°C) or 150W at 50°C.

The converters are packaged in a 3U x 4TE x 160mm extruded aluminium case. A 20mm profile is achieved by the use of a planar transformer, together with hybrid control circuits. Conversion efficiency is up to 90%. Single and dual output modules are available providing 5V to 48V, or +/-5 to +/-24V DC with external adjustment from 50% to 110%.

The inrush current is below prETS 300-132-2 levels, allowing users to hot-plug. Units can be parallel connected with single wire current sharing. An isolated 'out OK' signal and LEDs show the module's status. Other safety features include a secondary independent control loop to limit the output voltage and prevent damage due to incorrect sense line connection, continuous short circuit and open circuit protection as well as over-temperature shutdown.

Safety isolation levels are in accordance with EN 60950, VDE 0805 and the European telecom specification EN 41 003, with approvals from UL and LGA. RFI performance is below VDE 0871, level B, EN 55 011/22, level B, and transient susceptibility is according to specifications EN 61 000-4-2, 3, 4 and 5.

For further information circle 245 on the reader service card or contact Scientific Devices Australia, 2 Jacks Road, South Oakleigh 3167; phone (03) 9579 3622.

1000V miniature ceramic capacitors

Philips has recently extended its range of miniature ceramic plate capacitors with a new 1kV (DC) series. The series covers capacitance values from 0.47pF to 3300pF with tolerances of +/-0.25pF or 5% for SL types and +/-10% or +/-20% for class II types. Operating temperature range is -55 to +85°C, with some types having an extended temperature rating of +125°C for use in power supplies, electronic ballast circuits, automotive circuits and professional applications. Low loss types are also available where heat dissipation is a critical factor.

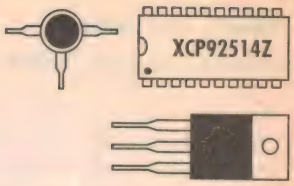
The new components are made to the same standards as the rest of Philips' ceramic plate capacitor range. The leads are flanged for better positioning on the PC board, improved definition of component height and reduced stresses on the capacitor during automatic insertion. The flanges also improve solderability by preventing the lacquered tops of the leads from entering the PC board holes and hindering the escape of flux during soldering.

The flanged leads are claimed to have a lower self inductance than the kinked leads used by other suppliers, giving a better high frequency behaviour and higher resonant frequency. The capacitors are also supplied with copper electrodes rather than silver, since this has been found to improve DC behaviour (by eliminating silver migration), and to enhance reliability.

For further information circle 251 on the reader service card or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 9805 4479. ❖

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY



Charger IC for all battery types

Philips has released a single chip fast-charge controller IC able to handle all common battery types. The TEA1102 is claimed by Philips to be the world's first single chip fast-charge controller for nickel cadmium (NiCad), nickel metal hydride (NiMH), lithium ion (LiIon) and sealed lead-acid (SLA) batteries.

To ensure that the full-charge condition is reliably detected in NiCd and NiMH battery packs, the TEA1102 uses both dT/dt (rate of change of battery temperature) and peak voltage detection. The two detection modes can be selected individually, or used together. If temperature detection is selected, the IC will automatically switch over to peak voltage detection if the battery pack's temperature sensing thermistor fails.

For SLA and LiIon batteries, fast charging is stopped when the battery reaches a predetermined voltage level. The IC has linear and PWM outputs to control linear or switch-mode current regulator transistors and the fast-charge current can be programmed to values between 0.5 and five times the battery's nominal ampere capacity. Single-cell or multiple-cell battery packs can be charged.

The IC has three automatically sequenced charge states for NiCad and NiMH batteries. The first brings them rapidly to full charge, followed by a 'top-off' charge for a pre-determined period to ensure full capacity. Finally the IC reverts to a continuous float-charge. It can also operate as an AC/DC adaptor if the battery pack is removed, delivering a regulated voltage output rather than a pulsed charging current.

For LiIon and SLA batteries, the IC automatically switches over from current regulation to voltage regulation when these batteries reach their maximum voltage (adjustable). After a defined period, which is dependent on battery capacity and charging current, charging is terminated. Due to the small self-discharge rates of LiIon and SLA batteries, trickle charging is not necessary.

Other features of the TEA1102 include manually activated discharge of NiCad batteries before recharging to overcome memory effect, minimum and maximum temperature protection, short circuit and time-out protection, and outputs for LEDs and a buzzer to indicate charging conditions. The IC is available in 20-pin DIP or SO packages.

For further information circle 271 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 805 4479. Philips' Home Page is at **http:/www.semiconductors.philips.com**.

IC for bigger, hi-res displays

National Semiconductor has announced the first 3V, 65MHz members of its FPD-Link family of host-to-LCD interface devices. Based on LVDS (low voltage differential signalling) technology, the DS90C383 transmitter and the DS90CF384/CF364 receiver are claimed to provide portable computer manufacturers with a way to upgrade to larger LCD screens that support XGA or SVGA resolution, while at the same time reducing power consumption.

Four barriers had to be overcome by National. The first barrier was bandwidth, caused by the increased resolution of the LCD screen. The second was the higher

clock rate generating more electromagnetic interference (EMI). The third was higher addressability requirements which require a wider cable/connector interface, and higher cost. Finally, the issue of minimising power within a system without compromising noise, cost and speed.

To solve these problems, the FPD-Link family uses a combination of LVDS signalling and a clock-splitting technique that allows data serialisation. For example, the interface to a 1024 x 768 XGA LCD with 24-bit colour requires 10 lines (instead of the usual 52). An SVGA interface with 24-bit colour also requires 10 lines.

The lower number of lines help keep EMI low, along with the reduced voltage swing and differential nature of LVDS.

For further information circle 272 on the reader service card or contact National Semiconductor, Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 9558 9999.

Electronic fluoro lamp starter IC

The new UBA2000T electronic TL-lamp starter IC for fluorescent strip lights from Philips Components is claimed to provide perfect ignition conditions for

working tubes, and to prevent wasted attempts to light dead tubes. To ensure compatibility with existing equipment, the UBA2000T and all its associated components can be fitted in a standard glow switch starter casing.

By counting AC line cycles after the strip light is turned on, the UBA2000T generates a precisely defined electrode preheat period of 1.52 seconds for 50Hz supplies or 1.27 seconds for 60Hz supplies. During this time it turns on an external thyristor or MOSFET to allow pre-heat current to flow. After the preheat period, the external switching device is turned off at a guaranteed level. This ensures that sufficient striking voltage is generated by the inductive lighting ballast to instantly ignite the fluorescent tube.

If the tube doesn't ignite first time, a reduced pre-heat time of 0.64 seconds (50Hz) or 0.53 seconds (60Hz) is applied and a second attempt is made at ignition. If the tube has still not ignited after seven attempts, the device is latched into its off state until reset by turning the AC line supply off and on again. When a failed tube is replaced by a new one, the starter resets during the replacement action and ignites the new tube immediately.

The point in the AC line cycle at which the pre-heat current is turned on is controlled so harmonic currents generated in the AC supply are kept within EMC limits. The IC requires five or six external passive components, a bridge rectifier and a gate turn-off thyristor or MOSFET switch. It comes in an 8-lead small outline surface mount plastic package.

For further information circle 276 on the reader service card or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 9805 4479. Philips Home Page is at **http:/www.semiconductors.philips.com**.

Stereo bridged audio power IC

National Semiconductor has announced the latest addition to its family of 'Boomer' audio amplifiers. The dual bridge connected LM4863 audio amplifier is specifically designed for laptop or desktop computer sound systems, and is also suited for powered speakers or portable video games. The device can drive stereo headphones or stereo speakers, with up to 1.5W per channel as a speaker driver.

Several features make the device suited for portable applications. In speaker mode, the IC typically delivers 1.5W continuous average power to an 8Ω speaker bridge-tied load (BTL), with 10% typical total harmonic distortion (THD). Using a conventional stereo connector, the device switches to single-ended output mode for driving stereo headphones. The amplifier takes 11.5mA in active mode and 0.7uA in power-saving shutdown/mute mode. It operates with either a 3V or 5V power supply. An internal thermal shutdown mechanism protects the device from overheating.

The IC features circuitry to suppress pops and clicks at switch on, and operates without bootstrap capacitors or snubber networks. It is currently available in either a 16-pin small surface mount package (SOIC) as the LM4863M, or a 16-pin dual in-line package (DIP) as the LM4863N.

For further information circle 275 on the reader service card or contact National Semiconductor, Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 9558 9999.

2Mb BurstRAM runs at 100MHz

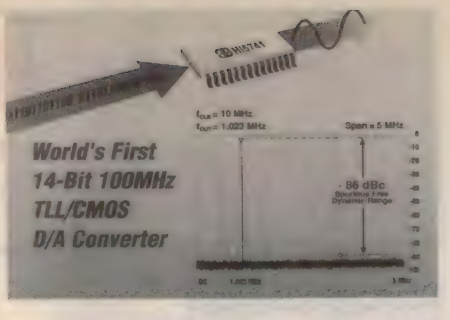
Motorola's Fast Static RAM Division has announced its new two megabit, 64K x 32, MCM63P631 BurstRAM, designed for multimedia personal computer applications which require 512K bytes of L2 cache. The device is claimed to allow system bus speeds up to 100MHz, with both linear and interleaved burst sequence capability. It also incorporates a sleep mode for improved power consumption.

Features of the device include single 3.3V +10% -5% supply; 100MHz maximum clock rate; selectable burst sequence order (linear/interleaved); byte write and global write control inputs; Intel PBSRAM 2.0 compliance; single-cycle deselect timing. It comes in a 100 pin TQFP (thin quad flat pack) package.

For further information circle 277 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 9887 0711.

100MHz 14-bit DAC

Claimed as the industry's first 14-bit, 100MHz digital to analog converter (DAC), the H15741 from Harris Semiconductor can provide a 20-fold voice channel capacity increase (before time or code division multiplexing) per baseband to intermediate frequency (IF)



chain. The DAC costs less than $100 (quantity 1000), but is claimed to provide intermodulation performance previously available only from $10,000 discrete rack-mounted DACs. Harris Semiconductor has submitted three patent applications related to the device.

According to Harris Semiconductor, the highest resolution monolithic DACs with 100MHz and faster update rates previously available were 12-bit devices. Although aimed at base stations and other wireless applications, the device is claimed to be able to deliver the same performance in proposed asymmetric digital subscriber line (ADSL) systems for high-speed digital communication over copper telephone lines. The DAC is also suitable for high-end instrumentation, such as spectrum analysers and waveform generators.

Key specifications include 14-bit resolution, 100MHz update rate, 650mW power consumption, 3ns setup time and 500ms hold time. Differential non-linearity (LSB) is +/-1.0 (max) and integral non-linearity (LSB) is +/-1.75.

For further information circle 278 on the reader service card or contact B.B.S. Electronics Australia, Unit 24, 5-7 Anella Avenue, Castle Hill 2154; phone (02) 9894 5244. ❖

Silicon Valley NEWSLETTER

Startup develops tiny pager/e-mail/fax

A small Silicon Valley startup firm is reportedly close to announcing its development of a device the size of a pack of cigarettes that will enable users to both receive pager, e-mail and fax messages, as well as transmit e-mail and fax messages to any e-mail address.

PocketScience of Santa Clara has not announced a launch date for the device, but those who claim to have seen and beta tested the device believe the firm may do so in the coming months. "It is like a pager that sends and receives e-mail," said one of the people who has tested the device.

Besides sending and receiving e-mail and pager messages, the device will transmit faxes of up to 350 words. It would be the first on the market that will enable users to both send and receive pager and e-mail data. It reportedly resembles the 'clamshell' design of pocket organizers, with a flip-top display and small keyboard below.

The device will also include a database utility, address book, electronic calendar, and to-do list. Like a pager, it beeps or vibrates when a message is received.

PocketScience will reportedly seek to license the device to traditional pager and other consumer electronics products manufacturers, who have the marketing muscle and distribution organization to bring the device to market successfully. Royal Consumer Products, an Olivetti subsidiary is expected to be among the first OEMs and may launch the device as early as January for a retail price of around US$150.

PocketScience was founded by former engineers and executives at Apple Computer and IBM. The firm is supported by venture capital and intends to position the device as a cheap alternative between cellular telephones and pagers.

IBM pumps $1.3B into San Jose plant

IBM has announced a major committment to its hard disk drive business, including an additional US$440 million increase in financial commitments for expanding the San Jose based Storage Systems Division. Included in the program is the construction of what IBM says will be the world's largest disk drive manufacturing facility, to be located in San Jose.

IBM said $440 million was additional to existing SSD investment commitments of US$600 million and $380 million, for a 1997 total of $1.3 billion.

The new disk drive facility will open in 1998 and will enable the company to double its disk drive output from 11 million units in 1996 to 22 million in 1998.

Although IBM has been the industry leader in disk drives for mainframes, and has also done well in drives for portable computers, the company wants to make a major move into the mainstream desktop PC market where Seagate remains the dominant supplier. Currently Seagate accounts for about half the US$27 billion PC disk drive market worldwide.

Japan forms its own Sematech

One of the most unexpected developments in recent industrial history has been the decline of the Japanese chip industry. However in December a new joint government-industry chip technol-

At the recent COMDEX show Swan Instruments of Santa Clara claimed industry leadership with its new UHD (ultra high density) floppy disk technology, which puts up to 130MB onto a single 3.5" disk that is backwards compatible with existing floppies. Data transfer rate is a speedy 3MB/s, and the drives will be available in early 1997.

ogy development program began in Japan, aimed at restoring its memory chip industry to world leadership.

The new joint government-industry program is not unlike the US Sematech effort. It has begun with a projected five-year budget of between US$500 million and $1 billion and will aim to develop the chip design and manufacturing capabilities to bring Japan back to the front ranks of the world's computer chip industry.

This time, however, the program will have to do without the market protection measures that helped boost the Japanese industry the first time around by keeping more advanced, less expensive foreign-made chips out of the domestic market. Although far less strict than the previous three agreements, the recently adopted US-Japan semiconductor trade agreement will ensure that Japan does not reconstruct the trade barriers that kept foreign competition out of the market for nearly three decades.

Samsung to make 5M PC monitors for IBM

IBM will purchase US$2 billion worth of computer monitors from Korea's Samsung over the next three years, under the terms of a deal just announced. The agreement calls for Samsung to deliver some five million 15" and 17" monitors to IBM, to be used primarily with desktop PCs.

Samsung is already the world's leading computer monitor supplier, with exports of around 10 million monitors expected for 1997 — up from eight million in 1996.

For Samsung the IBM deal means both an important vote of confidence by the world's largest computer manufacturer, and also a sizable measure of stability added to the company's monitor operations in 1997.

Although important for Samsung's financial outlook for 1997, the deal will not contribute enough to Samsung's financial picture to compensate for the losses in the company's DRAM memory operations, which continue to suffer from excess supply of 16-megabit chips.

New boss for Sematech

Sematech, the US chip industry's research consortium, has appointed Mark Melliar-Smith, a veteran semiconductor industry executive from AT&T, as its third president since the group's formation in 1987. Melliar-Smith's appointment was effective from January 1. He replaces William Spencer, who served as the consortium's president since 1990, following the death of Intel cofounder Robert Noyce. Spencer will continue as Sematech's chief executive through the end of 1997, when Melliar-Smith will assume that title as well.

Most recently Melliar Smith was chief technical officer for the Microelectronics Group of Lucent Technologies, one of the AT&T spinoffs.

The new Sematech chief faces a fresh set of challenges. For a start, during 1997 Sematech is severing its financial ties with the US government, which has pumped about US$100 million into Sematech each year since 1988. All of the group's future funding will have to be raised through its member companies.

Layoffs at Seagate, VLSI Technology

Silicon Valley companies VLSI Technology and Seagate Technology laid off close to 600 people as they shut down production lines for older products.

VLSI in San Jose said its logic chip plant has become obsolete now that Intel has incorporated the features found on VLSI's specialty logic chips into its new Pentium chips.

"The process technology in the San Jose fab doesn't meet our technological needs", said Greg Kaufman, VLSI's director of public relations. Kaufman said the company had tried to sustain the San Jose plant by working as a subcontractor and making chips for other semiconductor companies at the plant. But even that was not enough to keep the production lines going, Kaufman said.

"VLSI has rapidly moved its focus onto other types of communication-related chips, used in wireless communications and set-top boxes associated with cable television."

The company said it will take a US$100 million charge against its upcoming fourth quarter financial earnings in order to cover the cost of laying off 300 people and closing down the plant. Worldwide, VLSI employs about 3000 people and had sales in 1995 of US$720 million.

Meanwhile, disk drive industry leader Seagate said its Recording Media group, which employs 2000 people in both Milpitas and Fremont, would have to shed 290 people working on an older production line. The recording media group was formed during the merger of Seagate and Conner Peripherals last February, when Seagate's old magnetics division joined Conner's disk division.

The production line scheduled for shutdown uses obsolete technology not suitable to making the recording media used inside today's hard drives.

TI-Samsung make $1B DRAM settlement

Texas Instruments, which has already earned hundreds of millions of dollars in royalties for its DRAM chip technology from Japanese chip makers, announced it has settled a patent infringement lawsuit with Korea's Samsung. The deal will net TI as much as US$1 billion in royalties over the next 10 years.

TI and Samsung had been engaged in a bitter legal dispute, after the Texas chipmaker accused the world's leading DRAM maker of infringing on its patents. The settlement both eliminates all pending legal action between the firms and replaces a previous five-year deal that expired in 1995. The new licence covers both semiconductors, personal computers, consumer products and telecommunications equipment. ❖

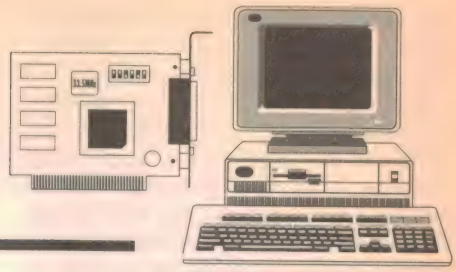
Bank updates its 'Wanted' posters...

Wells Fargo Bank, which turned 'bounty hunting' into a growth industry in the Wild West days of the 1800s, is returning to its roots by posting 'Wanted' posters on its Web site. Wells Fargo, the second largest bank on the West Coast, has started to put pictures up on its Web site. The 'Wanted' pictures come complete with rewards for tips that lead to the criminal's arrest and conviction, profiles of the individual, and details of the crimes they committed.

Wells Fargo's history of issuing bounties for bank robbers date back to the early days of the Wild West, when it posted 'Dead or Alive' posters around towns in the West for bank and stage coach robbers. So far, the bank has posted 11 criminals on the Web site. Already two of the men have been arrested, including one through a tip received by authorities over the Internet. On average, the web site draws more than 2500 hits a month, the bank said.

The bank is not the first to use the Internet for bounty hunting. Early in 1996 the FBI started listing the '10 Most Wanted' criminals on its Web site. That led in May to the arrest in Guatemala of one of the noted criminals after a teenager in that country, upon checking out the FBI's Web Site, recognized a visiting family friend as one of the men on the FBI list. FBI officials have said they expect the Internet to rival the TV Series 'America's Most Wanted' for catching fugitive criminals. The TV program has been credited with leading to the capture of more than 300 criminals since it started airing in 1988.

Computer News and New Products



29" computer monitor

The MegaScan VX29 and VX-29i series of display monitors feature a 29" diagonal flat, square-cornered tube, and can accept video inputs for VGA, RCA video, and S-VHS video (VX-29i only). The monitors also have stereo amplified speakers, VGA pass-through (to allow daisy chaining of up to three monitors) and (for the VX-29i) an infrared remote control. The monitors can be connected to a computer, VCR and S-VHS source simultaneously, allowing the user to switch instantly between signal sources using the remote control.

According to Alexander Hui of Mega Electronics: "The MegaScan series of monitors will revolutionise the way people interact with computer and multimedia applications. Uses for these monitors include conference rooms, training facilities, education, trade displays, teleconferencing applications, and home entertainment. Never before has such a versatile display monitor been available at an affordable price."

The monitors are covered by a two year warranty, and prices start from $2995 (RRP, excluding sales tax). Rental terms for business or government users are available.

For further information circle 163 on the reader service coupon or contact Mega Electronics, 2/50 Henderson Road Rowville 3178; phone (03) 9764 8900, email **mega@c031.aone.net.au**.

PCM optical modem

Optical Systems Design has announced its OSD170 G.703 PCM modem, claimed as a low cost, high performance PCM terminal designed primarily for in-house links such as PABX interconnects, 2.048Mb/s data switch links and the like. It operates essentially as an analog link optimised to transmit balanced ternary signals with peak amplitudes of 2.37V. It will transmit any standard G.703 signal from T1 (1.544Mb/s) to E2 (8.448Mb/s) without the need for user adjustments.

In its basic form, a regeneration function is not included as in most applications regeneration is provided by the customer's equipment. Operation at either 850nm or 1300nm is available. In either case sufficient power is coupled into standard 10/125um single-mode fibre to span distances up to 30km at 2.048Mb/s when operating at 1300nm. The modem

comes in a self-contained case which takes up half a modem tray in a standard 19" rack.

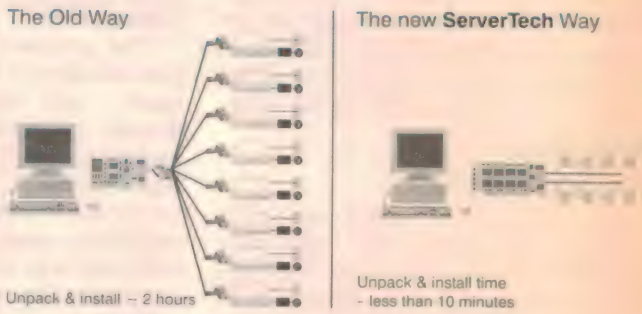
For further information circle 162 on the reader service coupon or contact Optical Systems Design P/L, Unit 7, 1 Vuko Place, Warriewood 2102; phone (02) 9913 8540.

Eight fax/modems on one ISA card

The new, Australian designed and manufactured ServerTech card has four or eight modems on a standard ISA bus plug-in card. The card is intended for networks, and appears on a Windows NT system as eight separate COM ports, each with an attached modem. Each port can therefore be set up for a different function — for example three ports for remote access by staff from home, two ports for network fax software and the remaining three for network modem pooling software.

The card is claimed to eliminate the need for serial extender cards, multiple serial cables to modems, power packs and plugs and to provide a greater level of security for the network. It will run with virtually any CPU and operating system that has an ISA bus. The card is based on Rockwell technology and is AUSTEL approved. The cost is around $500 per port.

For further information circle 166 on the reader service



coupon or contact ServerTech, Level 7, 91 Phillip Street, Parramatta 2150; phone (02) 9891 0088, web address **www.servertech.com.au**.

Data logger expands to 992 channels

The recently released TempScan/1100 from IOtech is the newest addition to the company's series of high-speed, multi-channel temperature and voltage measurement products. The unit is a rack-mountable, CE-compliant instrument with expansion capability up to 992 channels, and comes with TempView *Out of the Box* data logging software.

The software provides individual channel labelling and scaling, up to 32 user-defined alarm conditions and a live link to Excel, a widely used spreadsheet application. The program also supports a Hayes-compatible modem for remote communication from a PC to the TempScan/1100.

For further information circle 161 on the reader service coupon or contact Scientific Devices Australia, 2 Jacks Road, South Oakleigh 3167; phone (03) 9579 3622.

RS-232 card has four ports

Intelligent Systems Australia has announced the release of the PI-543, a four port RS-232 card. The card has four RS-232 ports for asynchronous communication and is suitable for MS-DOS, Windows and UNIX. It has selectable interrupts (IRQ2-IRQ15) for all ports. Ports are configured as COM1, COM2, COM3 and COM4. It is suitable for use with a BBS or a POS system and comes with a device driver that runs under MS-DOS.

For further information circle 160 on the reader service coupon or contact Intelligent Systems Australia, PO Box 118, Berwick 3806; phone (03) 9796 2290. Internet site at **http://www.intelsys.com.au.**

Video testing software

Intelligent Systems Australia has announced the release of DisplayMate for Windows, a system designed to show users how to set the parameters, controls and adjustments on a monitor and video board to optimise the system and obtain the best image quality. The product includes a setup program that shows how to quickly adjust the monitor for the best image, and a tune-up program that is claimed to further improve the picture quality by searching for any potential weakness of a computer monitor, and then showing how to improve the image.

The program provides detailed advice on how to obtain optimal picture quality, and takes advantage of parameter variations including the monitor scanning frequencies, video modes, even colour palette and the selection of colours and intensities. The program supports modes from monochrome to full 24-bit colour, including 16, 256, 32K, 64K, and 16.8M colour modes.

For further information circle 167 on the reader service coupon or contact Intelligent Systems Australia, PO Box 118, Berwick 3806; phone (03) 9796 2290. Internet site at **http://www. intelsys.com.au.**

32MB Flash card

AMD has expanded its D-Series Flash memory card range with the introduction of a 32MB high density card.

The company's D-Series Flash memory cards are based on the Arn29FO16, AMD's 16 megabit Flash memory device. They are already available in 4, 8, and 20MB densities and feature AMD's 5.0V-only Flash memory technology.

"With the extension of the D-Series cards, we can continue to provide customers a migration path to higher-density cards at a competitive cost", said Walid Maghribi, vice president and general manager for AMD's Non-Volatile Memory Division.

The D-Series cards are PCMCIA (Personal Computer Memory Card International Association) Type I, which makes them a small, lightweight, expandable, executable memory option and an attractive alternative to magnetic media, especially in embedded system applications. These applications include scientific and medical instrumentation, network hubs and routers, telecommunications and data acquisition systems. The cards are fully compliant with standards developed by PCMCIA (Rev 2.1) and the Japan Electronic Industry Development Association (JEIDA) 4.1 68-pin standard interface.

For further information circle 169 on the reader service card or contact AMD Australia, Level 14, 33 Berry Street, North Sydney 2060; phone (02) 9959 1937 or fax (02) 9959 1037.

16-bit DAQ on a PCMCIA card

National Instruments has announced three new PCMCIA (PC Card) cards for data acquisition (DAQ) applications using notebook computers running Windows 3.1 or Windows 95. The instrumentation-class DAQCard-AI-16E-4 and DAQCard-AI-16XE-50 analog input PC Cards are based on the company's popular E Series technology and pack the advanced functionality found on the company's full-size DAQ boards into the PCMCIA format. Also announced is the DAQCard-516, claimed to be the lowest-cost, 16-bit multifunction I/O card on the market. The three new products brings the total number of National Instruments PCMCIA DAQ products to nine — which NI says is the widest selection available today.

The DAQCards include NI-DAQ driver software, which can be used with PC/XT, AT, EISA, PCI, or PCMCIA products. NI-DAQ delivers a consistent hardware and operating system-independent API that protects the user's software investment. All of the DAQCards are compatible with the company's LabVIEW, LabWindows/CVI and ComponentWorks application software, as well as the company's Measure data acquisition software for Microsoft Excel and VirtualBench turnkey virtual instruments.

The DAQCard-AI-16E-4 and DAQCard-AI-16XE-50 deliver features such as analog triggering, equivalent time sampling, and high throughput rate that are found on the company's full-size E Series plug-in hoards. The cards are useful for high-accuracy measurement of temperature, strain, pressure and for rapid capture of transient signals, monitoring and digital control.

For further information circle 167 on the reader service card or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 5166 or fax (03) 9879 6277.

CCD camera for machine vision

JAI of Denmark have introduced their CV-M50 Machine Vision CCD camera, a state-of-the-art unit which uses a new extended grade 0.5" interline transfer HAD sensor to achieve high sensitivity, wide dynamic range and very low smear.

All functions, switching and operation mode settings are accessible through rear panel connectors including gain via a preset potentiometer. Auto gain can be switch selected.

2:1 interlace or non-interlace scanning is switch selectable. Sync can be internal or external by HD/VD or random asynchronous trigger. Pixel resolution is 752 x 582 and horizontal resolution 570 TV lines. Gamma is switch selectable, either unity or 0.45.

Signal to noise ratio is 55dB with AGC off and gamma at unity. Electronic Shutter is selectable in seven steps, from 1/100th to 1/10,000th of a second. The trigger shutter is selectable in eight steps from 1/60th to 1/10,000th of a second. Long time exposure is also available, from 1/30th of a second to infinity.

HD/VD or clock pulse outputs are provided for external image acquisition equipment when the camera is operating in the internal sync mode. Exposure Enable Pulse and Write Enable Pulse outputs are also provided.

The camera is housed in a rugged case designed for machine vision applications.

For further information circle 168 on the reader service card or contact The Dindima Group, PO Box 106, Vermont 3133; phone (03) 9873 4455 or fax (03) 9873 4749.

Single unit prints, scans and copies

The new Panasonic KX-PS600 multi-function device combines a laser printer, scanner and copier in the one unit. It is claimed as a true multi-function product because it is not based on a facsimile machine with added options.

The new product, which is aimed at the small office home office (SOHO) and personal executive market has a footprint of 188mm x 391mm. The printer function has a GDI mode for fast printing and has a duplex printing, with an overlay function that can print two or four pages on a single sheet of paper.

The scanner is TWAIN compatible and includes optical character recognition software plus the option to scan the document to any Windows program, the KXPS600 itself or to a fax modem. It features 300 x 600dpi automatic sheet-fed scanning from business card size to legal size paper, handling up to 20 pages at a time automatically. Photocopies can be made from a PC or it can be used as a stand-alone copier, even when the PC is switched off.

The unit comes with Windows software which provides text and image editing, as well as document filing. The unit is available from Panasonic Authorised Business Centres and computer specialists for an RRP of $1399.

For further information contact Panasonic's Customer Care Centre on 132 600. ❖

EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also, some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
Altronics	WA	•	•	•	•	•	•	•
Dick Smith Electronics	ALL	•	•	•	•	•	•	•
Emona Instruments	NSW						•	
Geoff Wood Electronics	NSW	•	•	•	•	•	•	
Jaycar Electronics	Eastern	•	•	•	•	•	•	•
RCS Radio	NSW			•				
Rod Irving Electronics	Eastern	•	•	•	•	•	•	•
Scientific Devices	VIC						•	
TECS	VIC	•	•	•	•	•	•	•

KEY TO CODING

A	Kits and modules	D	Components
B	Tools	E	IC chips and semiconductors
C	PC boards and supplies	F	Test and measuring instruments
		G	Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Company, P.O. Box 199, Alexandria 2015; phone (02) 9353 9992.

BACK ISSUES: Available only until stocks are exhausted. Price A$7.50 which includes postage within Australia only. **OVERSEAS READERS SHOULD ADD A FURTHER A$2.50 FOR EVERY BACK ISSUE REQUIRED.**

PHOTOCOPIES: When back issues are exhausted, photocopies of articles can be supplied. Price $7.50 per project or $15 where a project spreads over several issues.

PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, $10 for larger boards. Please specify negatives or positives.

PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications. **Members of our technical staff are not available to discuss technical problems by telephone.**

OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

READER SERVICES BULLETIN BOARD: (02) 9353 0627; ANSI, 24 hour access; any rate to 28.8kb/s.

PAYMENT: Must be negotiable in Australia and payable to Electronics Australia. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).

ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria NSW 2015; phone (02) 9353 0620.

PLEASE NOTE THAT WE ARE UNABLE TO SUPPLY BACK ISSUES, PHOTOCOPIES OR PCB ARTWORK OVER THE COUNTER.

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Mastercard, American Express, Visa Bankcard (please circle applicable card).

Expiry date:.....

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ADVERTISING INDEX

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

#104

PIR MOVEMENT DETECTOR
Commercial quality 10-15M range PIR movement detectors. Second hand, tested and guaranteed, have relay contact outputs, a tamper switch and operate from 12V DC. Compatible with standard alarm systems. Includes circuit: **$10** ea or 4 for **$32**

PIR SENSORS
Dual element Heinam LH1958 sensor plus fresnel lens: **$5** or 5 for **$20**

PIR CASE FOR CCD
Used cases from PIR movement detectors, with Fesnel lens and PCB. Ideal as a case to conceal a CCD camera: **$2.50** ea or 4 for **$8**

COMPUTER CONTROLLED STEPPER MOTOR DRIVER KIT
PCB and components kit plus information booklet and IBM software. Includes two stepper motors: **$44** Cable and power supply not included.

LASER POINTERS
Two 5mW at 660nm (very bright!) laser pointers. One a small flat plastic case, the other in a small metal cylindrical case fitted with a keychain. Greatly reduced prices: **$55** ea

UV MONEY DETECTOR
Small complete unit with cold cathode UV tube, works from two AA batteries (not supplied). Inverter can dimly light a 4W fluoro tube: **$5** ea or **5 for $19**

GEIGER COUNTER KIT
Based on a Russian Geiger tube, has traditional 'click' to indicate each count. Kit includes PCB, all onboard components, a Money Detector (see above), speaker and YES, the Geiger tube is included: **$30**

PLASMA EFFECTS SPECIAL
Ref: EA Jan '94. PCB and all on-board components (flyback transformer included), and instructions: **$28** Amazing results if used with a non-functional but gassed laser tube, available for an additional **$14** if purchased with the plasma kit.

RARE EARTH MAGNETS
Very strong!!! Zinc coated. Cylindrical: 7 x 3mm, **$2** (G37) 10 x 3mm: **$4** (G38), toroidal 50mm outer, 35mm inner, 5mm thick: **$9.50** (G39)

IR REMOTE CONTROL TESTER
Kit includes a blemished fibre optic coupled IR converter tube and our night vision HT power supply kit. The tube responds to IR and visible light, and can 'see' the output of an IR remote control: **$30**

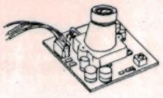
LED FLASHER KIT
3V operated 3-pin IC that flashes 1 or 2 high intensity LEDs. Very bright and efficient. IC, two high intensity LEDs and small PCB: **$1.50** ea, 10 for **$12**

SIMPLE MUSIC KIT
3V, 3-pin IC plays a single tune. Two ICs that play different tunes, speaker and small PCB: **$3** ea, 10 for **$25**

MAGNIFIERS - LOUPES
Small jewellers eyepiece: **$3**, 30mm loupe: **$8**, 75mm loupe: **$12**, 110mm loupe: **$15.** Set of one each of these magnifiers: **$30**

VISIBLE LASER DIODE KIT
Redesigned 5mW 660nm visible laser diode kit so the PCB fits into a new hand held case (supplied). Complete pointer kit (with case) at a REDUCED PRICE of **$35.** A similar kit with a 5mW 635nm laser diode: **$85** (NEW LOW PRICING)

STEPPER MOTOR PACK
Pack of seven mixed stepper motors. Save 50%! All new: **$36**

CCD CAMERA WITH BONUS

Tiny (38x38x27mm) CCD camera, 0.l lux, IR responsive (works in total dark with IR illumination).
Connects to any standard video input or via a modulator to aerial input: **$125.**
Bonus: With each camera you can buy the following at reduced prices:
- Commercial UHF modulator for **$15** (normally $25)
- IR illuminator with 42 880nm LEDs (940nm is relatively useless) **$25** (normally $35)
- *Regulated* 10.4V plugpack for **$10** (normally $25)

WARNING
Beware of lower prices for a similar camera. You might find you have to spend several thousand dollars to qualify. As well, our price is the same for credit card purchases.
We believe our price is the lowest in the country, but phone us if you find otherwise.
Also, phone us for a special price on bulk purchases — we won't be undersold!

CAMERA - TIME LAPSE VCR RECORDING SYSTEM
Includes PIR movement detector and control kit, plus learning remote control. Combination can trigger any domestic IR remote controlled VCR to start recording when movement is detected, and stop recording a few minutes after movement stops: **$90**

LOW COST IR ILLUMINATOR KIT
Allows a CCD camera or a night viewer to work in the dark. Adjustable power, 10 to 15V operation at 600mA (max). Has 42 IR 880nm LEDs (not relatively useless 940nm): **$35**

WE HAVE MOVED
We have now moved to new premises. Our postal address is the same, but see below for our new phone and fax numbers.

ARGON-ION HEADS
Used Argon-Ion heads with 30-100mW output in the blue - green spectrum. Head only supplied. Needs 3V/15A AC (for filament) and approx 100V/10A DC for the inbuilt driver circuitry. Power supply circuit provided. Size: 35x16x16cm, weight 6.0kg. 1 year guarantee on head. Needs a 1kW transformer, available elsewhere for about $170. Argon head only: **$400**

AUTOMATIC LASER LIGHT SHOW KIT
Three motors, mirrors, PCB and component kit, has laser diode regulator. Can be cased and operated from a computer. Produces a huge range of patterns: **$70**

DIGITAL RECORDING MODULES
Small voice recording modules as used in greeting cards. Powered by watch batteries (included). Also includes a suitable mini electret microphone. 6 second module: **$9**

LARGE VALUE USED ELECTROS
Brands include Sprague, Mallory, Seimens, Mepco, GE. Typical values: 5.4kµF-30V, 6kµF-50V, 40kµF-75V 9.6kµF-200V, 3.3kµF-200V: **$3–$8** ea

STANDARD PIEZO TWEETERS
Square, 85x85mm, 4-40kHz, 35V RMS: **$8**. 67x143mm, 3-30kHz, 35V RMS, wide dispersion: **$9**

IR REPEATER KIT
Extend the range of existing remote controls up to 15m and/or control equipment in other rooms: **$18**

MISC USED LENS ASSEMBLIES
Unusual lens assemblies from industrial equipment: **3** for **$22**

VISIBLE LASER DIODE MODULE
5mW/650nm laser diode module with adj. focus, ideal for making a complete disco laser with other components listed here: **$70**

12V - 2.5W SOLAR PANEL KIT
US amorphous glass solar panels 305 x 228mm, Voc 18-20V, Isc 250mA: **$22** ea, 4 for **$70**
Efficient switching regulator kit, suits 12-24V batteries & 0.1-16A panels: **$27**. Simple shunt regulator kit: **$5**

NEW NICAD BATTERY BARGAIN
6 PACK (7.2V) of 1.2V/800mAh AA NICAD cells, plus a thermal switch: **$4** per pack (of 6) or 5 packs for **$16**
Flat rectangular (48x17x6mm) 1.2V 400mAh NICADs with thermal switch: **$4** per pack or 5 packs for **$16**

MASTHEAD AMPLIFIER
MAR-6 IC-based high performance low-noise masthead amplifier covers VHF-FM-UHF. Includes two PCBs, all on-board components and a balun former: **$15** for basic kit. Suitable plugpack: **$6** Waterproof box for masthead amplifier: **$2.50**, plastic box for combiner: **$2.50**

12V BATTERIES AND INTELLIGENT GEL CHARGERS
Intelligent 'plugpack', 240V-12V gel battery chargers, 13.8V/650mA, proper 'switching' design, with LED status indicator: **$8.80**
New fresh stock of 12V/6.5AH SLR batteries (Hitachi): **$33** ea

MIDI KEYBOARD
Quality MIDI keyboard with 49 keys, 2-digit LED display, MIDI out jack. Size: 655 x 115 x 35mm. Computer software included: **$80** 9V DC plugpack: **$10**

GAS SENSORS
General purpose combustible gas and alcohol sensor, with data: **$18**

STEREO FM TRANSMITTER KIT
FM **STEREO** transmitter, tuning range: 88 - 108MHz, supply 6-12V, current 8mA (@ 9V), PCB size 25 x 65mm. Kit includes PCB and all on-board components, 9V battery connector, and 2 electret microphones: **$25** Plastic case to suit: **$4**

POWER MOSFETS
IRFZ44 N-channel MOSFETs at a realistic price. 60V (max), 0.028 ohm on-resistance, 50A (max). TO220AB package: **$4** ea, 10 for **$30**

MINIATURE FM TRANSMITTER
Very small ready-made FM transmitter in a small black metal case. Powered by a 1.5V watch battery (included), has an in-built electret microphone. Tuning range: 88 to 108MHz (adjustable). Range approx 50m: **$32**

WOOFER STOPPER
Ref SC Feb '96. Kit includes PCB, all on-board components, transformer, electret microphone, one piezo speaker: **$39** Approved 12V DC 1A plugpack: **$14** *NOTE*: Works with most wildlife, including kangaroos.
Up to 3 additional piezo speakers with each kit: **$6** ea. Previous purchasers can take advantage of this offer.

SOLID STATE PELTIER DEVICES
12V 4.4A, can be used to make a thermoelectric cooler - heater. Basic info included: **$25** 12V DC fan: **$8**

COMPUTER POWER SUPPLY
Standard large supply as used in large computer towers. 5V/22A, +12V/8.5A, –5V/0.5A, –12V/0.5A. Used but in excellent condition. Guaranteed: **$30**

WIRELESS IR EXTENDER
Converts the output of any IR remote control unit to a UHF transmission. Tx is self-contained (includes battery), attaches with Velcro strap under IR transmitter. Rx has 2 IR LEDs, and is placed near appliance being controlled. Kit includes two PCBs, all components, 2 plastic boxes, Velcro strap: **$35.** (9V battery for transmitter not supplied.) Suitable plugpack: **$10.** Components for 24V: **$1.50**

COMPUTER CASE AND SUPPLY
New, low profile metal computer case with a quality Australian made switch mode power supply: 240V AC to 12V/2A DC and 5V/5A DC. Includes IEC (I/P and O/P) connectors, fuse and switch. Off white, 50(h) x 360(w) x 380 (d) mm. Great for projects, CB power supply etc: **$20**

CENTRAL LOCKING KIT
A complete central locking kit for any vehicle. Good quality, with Mabuchi motor actuators. Can be controlled from existing UHF remote controls. Kit includes 4 actuators, control box, wiring harness, screws-nuts, other mechanical parts: **$60.** Actuators are available separately: **$9** ea

CODE HOPPING UHF CENTRAL LOCKING KIT with UHF REMOTE
Uses code hopping encoder and decoder ICs for ultimate security. Similar to the above system, but has built-in UHF receiver. Includes two matching 2-button UHF transmitters. One button locks, the other unlocks. Receiver has 3 relays: two for central locking and one that's activated in the lock position — for immobiliser etc. Kit also includes 4 actuators, control box, wiring harness etc: **$109**

UV MONEY DETECTOR
Small complete unit with cold cathode UV tube, works from two AA batteries (not supplied). Inverter can dimly light a 4W fluoro tube: **$5** ea or **5 for $19**

GEIGER COUNTER KIT
Based on a Russian Geiger tube, has traditional 'click' to indicate each count. Kit includes PCB, all onboard components, a Money Detector (see above), speaker and Geiger tube: **$30**

OATLEY ELECTRONICS
PO Box 89, Oatley NSW 2223
Phone (02) 9584 3563
Fax (02) 9584 3561
orders by e-mail: oatley@world.net
WEB SITE: http://www.ozemail.com.au/~oatley
major cards with phone and fax orders, P&P typically $6.

Put us to the test... and see how we measure up.

Hewlett-Packard Test and Measurement, a range of over 3200 leading edge products - and they're all as close as the phone.

Simply by contacting our highly trained call centre professionals, you'll receive expert advice about which products measure up to your requirements, quotations that land on your desk today... not next week, and delivery to your door.

The Hewlett-Packard Test and Measurement call centre, it's your central point of contact when you need the right answers on the right products, so put us to the test... **and see how we measure up!**

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